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ABSTRACT

Presented are 15 papers on the theory of evolution and the evolution-creationism equal-time controversy. The papers can be divided into three categories: (1) a set of papers dealing with legal or constitutional considerations; (2) a group of resolutions, official positions, and personal viewpoints; and (3) several semi-technical articles. Included are an article on the Tennessee "Genesis Law," a statement affirming evolution as a principle of science by the American Humanist Association, a presentation of papers at a California Board of Education hearing of religious leaders' views on the theory of evolution, and others. (BB)

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A Compendium of Information on The Theory of Evolution and the Evolution-Creationism Controversy

The National Association of Biology Teachers
11250 Roger Bacon Drive
Reston, Virginia 22090

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Foreword

During the past five years the National Association of Biology Teachers has received hundreds of requests for information regarding the theory of evolution, and the evolution-creationism "equal-time" controversy. This compendium represents an attempt to provide, under one cover, information to answer the majority of these requests.

The "equal-time" controversy first appeared in the 1920s when general assemblies and legislatures in twenty states considered enactment of laws calling for mandatory inclusion of the biblical story of creation in secondary school biology curricula. This was followed by a generally quiescent period of some four decades. Then, in the late 1960s, fundamentalist voices were once again raised in support of forced inclusion of biblical creationism in public school biology textbooks and courses.

In two states the furor was sufficiently strong to attract nationwide attention: in California where state guidelines calling for inclusion of fundamentalist creation doctrine in science textbooks were hotly debated, and in Tennessee where a state law calling for equal treatment of biblical creation in biology textbooks was challenged in the federal courts and found to be unconstitutional. The National Association of Biology Teachers was involved in both of these situations.

As a result of NABT's active involvement, the Association became the recipient of letters from school board members, parents, legislators, life science teachers, and interested citizens, all requesting information. Unfortunately, these requests were usually of a general nature (i.e., "please send all the information you have"), and responses frequently required substantial time and expense.

This compendium does not represent "all the information we have" on the theory of evolution, or the evolution-creationism "equal-time" controversy. However, it does include a sufficiently wide variety of articles and statements to provide answers to most questions received by NABT. As Executive Director of the Association, and respondent to requests for information, I assume full responsibility for selection of the contents of this compendium.

The contents could be divided into three major categories: first, a set of papers dealing with legal or constitutional considerations; second, a group of resolutions, official positions, and personal viewpoints; and third, several semi-technical articles. Perhaps the best is saved to last, as I strongly recommend the reader not overlook the final four articles by Moore, Cloud, Mayer and Alexander.

The National Association of Biology Teachers, a professional society for teachers of life science at all educational levels, has never issued an official resolution regarding either teaching the theory of evolution or the "equal-time" controversy. However, by its actions, NABT has clearly revealed its position; i.e., there is neither scientific nor constitutional reason for inclusion of fundamentalist religious doctrine in biology curricula, and the Association actively opposes attempts to mandate such inclusion. This compendium, therefore, includes only presentations that are scientifically sound, and viewpoints that support the teaching of biology as a science.

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In the event the reader requires additional data on the "equal-time" controversy, or desires information about the National

Association of Biology Teachers, its publications, programs, and purposes, write to the Association's headquarters at 11250 Roger Bacon Drive, Reston, Virginia 22090.

Jerry P. Lightner
30 June 1977

Revised
8 February 1978

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The Constitution and Creationism

Frederic S. Le Clercq

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In recent years many states have experienced attempts to legislatively mandate "equal time" for creationist doctrine in biology textbooks and other classroom materials. The author discusses the possibility that inclusion of such fundamentalist religious doctrine lacks any legitimate state interest and therefore violates guarantees found in the establishment, free exercise, free speech, and due process clauses of the Constitution.

As a national issue, the teaching of evolution in the public schools appeared to have been put to rest with the celebrated Scopes trial in Tennessee, almost half a century ago. When the Supreme Court finally invalidated a state "antievolution" law, in *Epperson v. Arkansas,* Justice Black in his concurring opinion seriously questioned whether the case presented a genuinely justiciable case or controversy, inasmuch as there had "never been a single attempt by the State to enforce it" and for "nearly 40 years after [passage] the law has slumbered on the books as though dead."

Evolution as a religiopolitical issue--fraught with all its potential for religious fragmentation and social discord--is now being revived and politicized by various groups of religious fundamentalists who espouse a "creationist" position. Creationists are making a determined effort to replace the theory of evolution in public school science textbooks with the doctrine of Divine or Biblical creation or its protean "scientific" counterpart, special creation. At the very least, creationists hope to dilute the theory of evolution to the level of hypothesis or speculation and to win equal time for the doctrine of special creation.

A Potent National Movement

Recent events suggest that the creationist movement is both potent and truly national in scope. In California, the science curriculum guidelines for public schools were modified by a sympathetic state board of education to accommodate the creationist position. Science textbooks for use in the public schools of California are being edited to dilute passages on evolution. Creationists almost succeeded in getting express recognition of their beliefs in science textbooks in California public schools. In Tennessee, a law has been passed that requires inclusion of the Biblical account of creation in biology textbooks used in the public schools. Legislation to require treatment of creationist doctrine in science textbooks was also introduced in state legislatures in Colorado, Michigan, Washington, and Georgia. Some local school boards, such as that of Columbus, Ohio, have passed resolutions to require inclusion of the creationist position. In Texas a creationist campaign won important concessions from the state board of education. Active creationist campaigns are also being conducted in Louisiana, Indiana, Florida, Illinois, Virginia, and Pensylvania, among other states. Creationists have threatened to seek relief from the courts under the Free Exercise Clause, although the first skirmish resulted in dismissal for failure to state a claim. Intensified creationist efforts can be expected in state legislatures and before state and local boards of education across the nation.

A creationist press has been organized, to arouse the public and to supply the demand for public school textbooks bearing a creationist imprimatur. Of even greater potential significance is the possibility that national school textbook publishing companies will edit school textbooks to accommodate the creationist position.

Ultimately, the issues raised in the controversy over science teaching and textbooks will probably have to be resolved in the courts. Litigation in California has thus far been forestalled as a result of a tenuous, and perhaps temporary, settlement. The issue will be litigated first in Tennessee, where the National Association of Biology Teachers and other, individual plaintiffs filed suit on 28 December 1973, contesting the inclusion of creationist doctrine in all biology textbooks used in the public schools.

What Is At Issue--On Both Sides?

The science teaching and textbook controversy, like many other issues arising under the religion clauses of the First Amendment, involves tension between the Establishment and Free Exercise clauses. The scientific community generally regards the doctrine of special creation as nonscientific and religious. Under this view, the inclusion of creationist doctrine in science classes would amount to an establishment of religion, which is proscribed by the First Amendment. State legislation or administrative regulations that require the teaching of creation doctrine or the inclusion of creation doctrine in textbooks would raise substantial Free Exercise questions for many teachers and students.

Creationist leaders and fundamentalist parents see the issue from a quite different perspective. For them, present science teaching and teaching materials amount to an establishment of a "secular religion" and interfere with the free exercise of the revealed truths of fundamentalist religion.

In *Epperson v. Arkansas* the U. S. Supreme Court held that state legislation cannot be justified by considerations of state policy resting solely on "the religious views of some of its citizens." The Court invalidated the Arkansas antievolution statute because it was "clear that fundamentalist sectarian conviction was and is the law's reason for existence." The original Tennessee antievolution law had "candidly stated its purpose: to make it unlawful 'to teach any theory that denies the story of Divine Creation of man as taught in the Bible and to teach that man has descended from a lower order of animals.'" Although the Arkansas law was "less explicit" in religious referents than the Tennessee law, the *Epperson* Court had "no doubt that the motivation for the law was the same: to suppress the teaching of a Divine Creation of man." The *Epperson* Court concluded:

> Arkansas' law cannot be defended as an act of religious neutrality. Arkansas did not seek to excise from the curricula of its schools and universities all discussion of the origin of man. The law's effort

> was confined to an attempt to blot out a particular theory because of its supposed conflict with the Biblical account, literally read.

The revived creationist thrust to win "equal time" for creationist doctrine rather than pursuing the strategy of the 1920s to "blot out" evolution may well have been conceived as a response to *Epperson*. Although "equal time" and "fair play" have far more public appeal than the simple negativism of the fundamentalist movement of the 1920s, one biologist recently pointed out that the "basic problem still remains, however--religion is not science."

The Right to Knowledge

Another important constitutional value implicit in *Epperson* is that in public educational institutions no religious group should be allowed to blot out a segment of knowledge "deemed to conflict with a particular religious doctrine." *A fortiori, no religious group should be allowed to compel inclusion of a segment of its particular religious doctrine in the public-school curriculum.*

An additional important constitutional value outlined by *Epperson* is the right of the individual "to engage in any of the common occupations of life and to acquire useful knowledge." This right to be free of "'arbitrary' restrictions upon the freedom of teachers to teach and of students to learn" is secured by the Due Process Clause of the 14th Amendment.

The *Epperson* Court explored the questions of vagueness and free speech but declined to base its holding on either ground. The Court considered of "no moment" uncertainty over whether the Arkansas statute "prohibits 'explanation' of the theory of evolution or merely forbids teaching that the theory is true," because "under *either* interpretation of its language the statute cannot stand." Thus, *Epperson* does not bode well for recent legislative and administrative proposals that, consistent with present creationist policy, are aimed not at a prohibition on the teaching of evolution but rather at a prohibition on oral or written representations that the theory of evolution is "true" or "scientific fact." The question in the science teaching and textbook controversy is whether or not oral or written communication regarding the doctrine of special creation in public school science classes constitutes "religious activity."

Although the Bible or Biblical doctrines are constitutionally appropriate in objective courses in religion, literature, or history, their use in science courses probably raises insurmountable problems under the Establishment Clause. The National Academy of Sciences recently enacted a resolution which declared that

> the essential procedural foundations of science exclude appeal to supernatural causes as a concept not susceptible to validation by objective criteria; and ...religion and science are... separate and mutually exclusive realms of human thought whose presentation in the same context leads to misunderstanding of both scientific theory and religious belief; and [that] Therefore...public school science texts [should] be limited to the exposition of scientific matter.

The Free Exercise and Establishment clauses forbid two quite different kinds of governmental encroachment upon religious freedom. The purpose of the Free Exercise Clause is "to secure liberty in the individual by prohibiting any invasions thereof by civil authority." The distinction between the two religion clauses is that a violation of the Free Exercise Clause is predicated on coercion. To determine the constitutionality of state action that allegedly impinges upon free exercise of religion, the courts resort to a balancing process, in which the interests of the state are compared or weighed in relation to other fundamental rights and interests that may be affected.

The Free-Exercise Question

The free-exercise question arises in two different contexts in the controversy over science teaching and textbooks in the public schools. First, is the doctrine of special creation a nonscientific, religious doctrine, the teaching or study of which could not constitutionally be required by the state in science courses? Second, does an opposition to the teaching or study of evolution, if grounded upon sincere religious belief, provide a basis for the exemption of students from compulsory science or biology classes?

It is well settled that the Free Exercise Clause is violated by state-imposed prayers or Bible reading in the public schools, because of the religious character of these practices. Nor may a state require an applicant for public office to swear or affirm a belief in a deity, because such a religious test "unconstitutionally invades the appellant's freedom of belief and religion." In *Torcaso,* the Court repeated and reaffirmed what it had said in *Cantwell* and *Epperson:* "that neither a State nor the Federal Government can constitutionally force a person 'to profess a belief or disbelief in any religion.'"

State legislation to require consideration of Biblical or religious explanations of creation in the science curricula of public schools raises substantial questions, under the Free Exercise Clause, that any student or faculty member whose religious freedoms were infringed would have standing to challenge. The place of the Bible "as an instrument of religion cannot be gainsaid." Biblical or other divine explanations of creation engrafted upon the science curricula of public schools assume a *religious* function of the character disapproved in *Schempp, Engle,* and *McCollum.* Also, whatever legitimate state interest there may be in acquainting students with Biblical or other divine explanations of creation can be served by means that do not offend the Free Exercise Clause; for example, such explanations may be presented *objectively* in a course in the sociology of religion, history of religion, or comparative religion.

The teaching of the doctrine of special creation apart from any Biblical referents may likewise offend the Free Exercise Clause. Special creation is a supernatural doctrine that presupposes a creator, the existence of which is empirically unverifiable. Because acceptance of the doctrine of special creation must be a matter of *faith*, it is a *religious* doctrine, the teaching of which in the public schools presents insurmountable obstacles under both the Free Exercise and Establishment clauses of the First Amendment.

Allegations of fundamentalist parents that the teaching of evolution to their children violates their fundamental parental rights and their freedom of conscience present a claim that, in the opinion of this writer, raises equally substantial questions under the Free Exercise Clause. In *Schempp* the Court was confronted with a claim that "unless these religious exercises are permitted a 'religion of secularism' is established in the schools." Although the phrase "religion of secularism" may be a semantic red herring, the claim raises far more difficult problems in the present context than in *Schempp*.

In his concurring opinion in *Barnette* Justice Murphy declared that "[o]fficial compulsion to affirm what is contrary to one's religious beliefs is the antithesis of freedom of worship... ." By the same rationale it could be contended that the Free Exercise Clause would be violated by compelling students to study science texts presenting data that tend to support the theory of evolution, if the effect of such study is to interfere with or destroy belief in religious doctrine inculcated in the home or the church. Religious beliefs founded upon a literal interpretation of *Genesis*--that the Earth was created in seven days or that Noah's flood was an historic event--are deserving of as much protection as the beliefs of the Jehovah's Witnesses, which were protected in *Barnette*.

Parents and Children

Most people in this country who subscribe to religious beliefs have developed belief systems that are either compatible with or are preserved in a sphere of the mind apart from the data, hypotheses, theories, and laws of science. The study of evolution in the public schools raises no free-exercise questions for them or their children. But for a minority of fundamentalists, the study of evolution, like the Wisconsin compulsory school-attendance law in *Yoder*, "does interfere with the freedom ...to act in accordance with... sincere religious belief." In *Yoder* the Court exempted Amish children who had completed the eighth grade and were participating in the "long established [Amish] program of informal vocational education" between the ages of 14 and 16 years from an otherwise lawful and generally applicable requirement that children attend school until age 16. The study of evolution data and theory by certain children of fundamentalist parents may, as in *Yoder*, carry with it the danger of censure by the church community and threat to the salvation of parents and children.

In *Yoder* the Court recognized that "the values of parental direction of the religious upbringing and education of their children in their early and formative years have a high place in our society." The "traditional interest of parents with respect to the religious upbringing of their children" can outweigh even the strong state interest in universal education, provided parents "in the words of *Pierce*, 'prepare [their children] for additional obligation.'" There may be parents who, as a result of deep religious conviction, feel themselves as much threatened by the study of evolution by their children as the Amish felt threatened by the compulsory-attendance law. Is the justification for "hydraulic insistence on conformity to majoritarian standards" any less in the case of the fundamentalist parent who on religious grounds objects to the study of evolution than in the case of the Amish parent who on similar grounds objects to compulsory education beyond the eighth grade?

Perhaps the social policy most consistent with the Free Exercise and Establishment clauses would permit exemptions from science courses (or portions thereof) of children whose parents request on religious grounds that their children be excused. The curtailment of employment and earnings potential, educational opportunities, and attainable lifestyle of children excused from biology or science classes is not nearly so drastic for those who do not go beyond the eighth grade. Such exemptions or excusals could forestall political efforts by fundamentalists to compromise the academic integrity of science textbooks and depoliticize the present controversy. If accommodation with the interests of fundamentalist parents could be realized by excusing their children from some or all science classes, then the establishment and free-exercise claims asserted by the majority to be free of creation doctrine in science teaching and textbooks (which are of equal or greater weight in this instance) could perhaps be avoided altogether.

In a matter as vital as education, there may be instances when the wishes of the child, especially as the child grows older, ought to prevail even over the parens patriae and free-exercise claims of the parent. The Court in *Yoder* admitted that the "power of the parent, even when linked to a free-exercise claim, may be subject to limitation under *Prince* if it appears that the parental decisions will jeopardize the health and safety of the child, or have a potential for significant social burdens." Cases involving declared *adverse* interests between parents and minor children over educational opportunity and free-exercise matters raise extremely difficult questions, which are left unsettled by *Yoder*.

The Establishment and Free Exercise clauses are probably violated by the Tennessee legislation and by the California science curriculum guidelines under which textbooks are now being edited.

Academic Due Process

The Establishment and Free Exercise clauses represent the most formidable constitutional barrier to creationist efforts to rewrite the science textbooks used in the nation's public schools and to win equal time for creationist doctrine in science teaching. But the controversy involves substantial claims of academic due process, which also deserve exploration.

The free-speech guarantee of the First Amendment has long been recognized as one of the "fundamental personal rights and 'liberties' protected by the due process clause of the Fourteenth Amendment from impairment by the States." Although control over the public school curriculum is, like public education generally, committed to the control of state and local authorities, the First Amendment "does not tolerate laws that cast a pall of orthodoxy over the classroom." Academic freedom is a "special concern of the First Amendment" because it is "of transcendent value to all of us and not merely to the teachers concerned." In *Keyishian* as in most other loyalty cases, the First Amendment has been invoked to protect speech and associational activities of teachers outside the classroom. A fortiori, speech inside the classroom on matters within the professional competence of the teacher deserves protection.

In *Shelton v. Tucker* the Court invalidated an Arkansas statute that, as a prerequisite to employment, required teachers in public schools to file affidavits giving the names and addresses of all organizations to which they had belonged or contributed within the preceding five years. Of course, there "can be no doubt of the right of a State to investigate the competence and fitness of those whom it hires to teach in its schools... ." But although the governmental purpose was both "legitimate and substantial" in *Sheldon,* the Court overturned the Arkansas statute because its purpose could have been achieved by less drastic means.

Shelton suggests the following observations pertinent to the controversy over science teaching and textbooks:

1. It is difficult to define a state purpose behind creationist legislation that is either legitimate or substantial. Such legislation certainly is not prompted by a compelling state interest of the magnitude necessary to justify restrictions upon intellectual freedom.

2. *Shelton* involves plaintiffs who taught in the public secondary schools (as well as a college teacher), in contrast to most of the loyalty cases, which have primarily involved college teachers. The proposition that "vigilant protection of constitutional freedoms is nowhere more vital than in the community of American schools" is applicable at the secondary and elementary levels as well as at the college level.

Application of the Free Speech Clause of the First Amendment to the public school classroom can satisfy the important societal goal of making the classroom a "market place of ideas." The primary function of the public school should be to encourage students to develop an appropriate methodology for engaging in intellectual *inquiry*. The method of inquiry appropriate to the science class is, of course, the scientific method. For the state to compel the science or biology teacher to devote classroom time to the explanation of creation doctrine, which is derived nonscientifically by revelation, authority, or induction, is an egregious abuse of the teacher's freedom of speech. The state has a legitimate interest in requiring that the science or biology teacher cover the subject in a professionally acceptable manner. Dismissal for failure of the teacher to perform in a professionally acceptable manner in the classroom is unquestionably the right of the state. In this sense, the state may properly regulate the classroom speech of the teacher. But the right of the state to regulate classroom speech should be limited to action that reasonably advances the legitimate interest of the state, which is to assure that the classroom performance of the teacher is professionally acceptable.

The freedom of elementary school and secondary school teachers to speak in a professionally responsible manner in the classroom enhances other important social values, as well. A substantial portion of the nation's young people do not attend college. For many of these students the public schools offer the only institutional opportunity to develop critical intellectual skills. For students who do attend college, the social interest in the freedom of classroom inquiry is equally important. To lay the proper foundation in science or biology for these students requires elementary and secondary teachers who are secure in their right to inquire and explain in a professionally responsible manner. The usefulness of the theory of evolution to explain and to organize empiric data cannot seriously be questioned. The science teacher's interest in communicating knowledge in terms of concepts that are commonly regarded as valid by the scientific community is a preferred type of speech, the social value of which should effectively insulate it against any conceivable state interest.

Although the techniques that can be used by teachers to stimulate intellectual inquiry may vary considerably with classroom level, the constantly questioning, nonindoctrinative pedagogy that perhaps characterizes good teaching at any level needs the breathing space afforded by the Free Speech Clause. Limiting the accountability of the teacher for classroom speech to extraconstitutional standards of professional acceptability would seem to be especially important at the secondary and elementary school levels, because the guild concepts of academic freedom and tenure do not provide nearly so much protection there as at the university level. The probability of political interference and the injection of community prejudice would appear greater at the public school than at the college level and the corresponding need for protection of First Amendment freedoms greater. The resolution of disputes between teachers and school administrators over classroom speech should be resolved, in the vast majority of cases, without resort to the judicial process as a result of negotiation or access to administrative hearings. Courts "do not and cannot interfere in the resolution of conflicts which arise in the daily operation of school systems and which do not sharply implicate basic constitutional values." Judicial interposition in the operation of the public school system "raises problems requiring care and restraint." But the courts should be available to redress clear abuses of administrative discretion. Although the task of establishing a judicially manageable standard of professionally acceptable classroom conduct is difficult, the task is not insurmountable. Comparable standards are regularly applied by the courts in professional malpractice and other tort cases.

The claim of the teacher on occupational grounds to transmit knowledge established within a discipline is supported by *Meyer*. However, the same result can be more easily reached on free-speech grounds without stirring the specters that offended Justice

Black so greatly in his emotional dissent in *Tinker*. State legislation requiring the inclusion of academically irrelevant materials in particular subjects, if arbitrary and without reasonable relation to any legitimate state interest, violates the Due Process Clause, because it violates the guarantees of the Free Speech Clause of the First Amendment as those rights are incorporated by or absorbed into the concept of liberty protected against state interference by the Fourteenth Amendment. The fact that the right of the individual to pursue a useful occupation has long been recognized as an interest of basic importance in our society might suggest the appropriateness of a strict scrutiny standard, *especially in view of the confluence of occupational and free speech rights*. Because education is generally recognized as a basic interest of the society, occupational rights essential to the educational process--for instance, the right of the teacher to organize a biology course upon the centrality of evolution, free from state requirements incorporating religious or other extraneous doctrines--are especially deserving of protection.

The science teaching and textbook controversy involves legislation that "'deprive[s],' 'infringe[s],' or interfere[s] with the free exercise of...[a] fundamental personal right or liberty." The asserted fundamental right is that of the science teacher to speak without arbitrary legislation that unreasonably imposes upon the teacher the burden of providing equal time for nonscientific doctrines that bear no reasonable relation to his discipline. The thrust of the science teacher's claim is not of the "affirmative and reformatory" type, which is regarded with disapprobation by the present majority on the Court. Even if the right of the teacher to speak were not considered fundamental in the sense that state interference with the right is deserving of special scrutiny, state interference with science teaching would still be subject to the traditional due process requirement that all state legislation must bear some reasonable relation to a legitimate state interest.

Several recent cases have extended procedural protections to protect the classroom speech of teachers from interference by vague regulations. A limited right to judicial review has been recognized even for nontenured teachers over school decisions on nonretention, although there is a division of authority on this point. Generally, these cases have involved situations in which teachers have used techniques or language or made assignments that were considered obscene or inappropriate. State legislation affecting science teaching and textbook selection would likewise be subject to review, although it is unsettled as to whether strict scrutiny should be used. It is highly questionable whether legislation recently enacted in Tennessee could survive scrutiny on vagueness grounds.

Selection of Textbooks

Most state or local boards of education administratively establish an "approved list" of textbooks for use in their public schools. However, few school boards have established textbook selection standards relevant to the question of sectarianism. Whether the state has a legitimate interest in screening textbooks, editing them for use in special state editions, or establishing an "approved list" of textbooks raises important questions of law and social policy. Does the state have an obligation in certain circumstances to proscribe, because of their content, the use of textbooks financed by state funds? If so, what procedural safeguards must be afforded? The novelty of these questions does not detract from their substantiality. The difficulties posed by these questions are comparable in scope to those raised in what Justice Harlan called "the intractable obscenity problem."

Strictly speaking, textbook selection is not pure speech; it is a type of *action* that intimately affects speech. But the textbook selection process could not be exempted from scrutiny under the Free Speech Clause without serious detriment to constitutional values. The relationship between the state and the publisher is a commercial one involving a willing buyer and a willing seller. But values closely associated with freedom of the press are at stake as well. To deny the applicability of free speech and free press guarantees in textbook selection would be to exalt form over substance. Technically, there may be no problems of prior restraint, because the state does not forbid the publication of a text prior to its approval. However, the nature of the commercial relationship fosters a situation in which the publisher may well subordinate the academic integrity of his product to satisfy his financial interest in a contract. Because of the important role of the textbook in the educative process and its critical relationship to intellectual freedom, it cannot be gain-said that textbook selection involves fundamental constitutional values that deserve protection under the First Amendment. This is a situation in which conduct is so invariably related to values protected by the Free Speech and Free Press clauses that judicial protection is necessary to prevent erosion of the constitutional guarantees.

At the college level the selection of textbooks is generally the prerogative of the individual professor or, in the basic survey courses, of the academic department. The expertise of the individual professor or of the department would generally be so much greater than that of any state administrative agency that the promulgation of an "approved list" from which the professor must select textbooks or other assigned materials would intrude significantly upon the intellectual freedom of the professor without enhancing any legitimate state interest.

The state has a legitimate interest in assuming the selection of academically appropriate textbooks. This interest is no greater at the public school level than at the college level; but, presumably, the academic expertise of the public school teacher is generally not as great as that of the college professor. (Still, one may raise the question of whether this presumption is warranted in *every* aspect of textbook selection.) Likewise, the state has an interest in limiting textbooks to those that, in the view of the commission, cover the subject matter in the most accurate, adequate, and professional manner. Deference to the selection policies of an administrative agency can be justified on the ground that the textbook commission possesses expertise greater than that of most individual teachers.

The state also has a legitimate interest in protecting its teachers from the blandishments of commercial publishers. (A related notion--that the state has an interest in large-scale purchases of textbooks, as a way to save money--has no practical foundation.) The textbook commission in its selection policies can also advance legitimate state interests in preventing the use of materials that would subvert constitutional rights. For example, the state has both a legitimate interest and a constitutional obligation to prevent the expenditure of state funds upon, or permit public school use of, textbooks that violate the Establishment and Free Exercise clauses or the Equal Protection Clause (related to matters of race). Likewise, the state should be constrained on free speech grounds from approving textbooks that suppress unpopular political or economic views while permitting the expression of the dominant views.

Standards and Responsibilities

An essential safeguard would be the

adoption of written textbook selection policies that are based upon reasonably ascertainable standards. The inability to promulgate standards that have an "ultimate, god-like precision" does not denigrate the societal interest in providing reasonably fair notice to teachers, publishers, and interested parents as to the grounds upon which public school textbooks are selected or edited. The standards would be subject to review for constitutional infirmities.

Although textbook selection generally should not be subject to strict scrutiny or to independent review of constitutional facts by appellate courts, there are occasions when strict scrutiny and independent review would be appropriate. Independent review under a standard of strict scrutiny would appear necessary whenever claims are asserted that state action abridges rights secured under the First Amendment or under the Equal Protection Clause where claims of race are involved. Because the Constitution forbids not only the establishment of religion but laws or practices *respecting* the establishment of religion, only a prophylactic standard would satisfy the exacting constitutional requirements. One possible standard might read as follows: *A textbook should be considered sectarian whenever it contains an explanation, assertion, or doctrine that the average person, applying contemporary community standards, would consider either religious or anti-religious.*

The standard should be based on reactions of the average person rather than the particularly susceptible person. This standard would in no way detract from the objective treatment of religion in a secular course, as envisaged in *Schempp*. Nor would it prevent the occasional assignment of religious materials if made in the context of an objective inquiry into religious writings. A less restrictive standard--one based on the dominant theme of the material as a whole (the *Roth* standard)--would not meet the exacting requirements of the Establishment and Free Exercise clauses. The proposed standard would also test the assumption of the majority in *Allen:* that there are *secular* textbooks for which state financing is constitutionally appropriate even when the pupil attends a parochial school. Unless a textbook is secular, it has no place on the approved list for the public schools; nor should it be approved for public financing by pupils attending parochial schools. If state review of textbooks used by students attending parochial schools creates constitutionally insuperable entanglement problems, then the rationale of the majority in *Allen* will have proved unworkable in practice.

Despite the difficulties of obtaining a manageable definition of religious material for Establishment and Free Exercise purposes, there is no way for the courts to avoid the issue without seriously undermining fundamental constitutional vlaues. In the school textbook controversy the most satisfactory accommodation would be to afford a limited preference for Establishment Clause and Free Exercise Clause rights over religious speech, for the following reasons:

1. There is ample time for children attending public schools to obtain religious instruction favored by their parents in the home and the church after school hours.

2. Many parents who wish their children to receive religious instruction while in school have the alternative of sending their children to parochial schools.

3. There are many sources from which children in public and parochial schools can obtain religious materials. The propriety of the inclusion of religious books on the shelves of public school or public libraries should definitely be resolved in favor of the rights of free exercise of religion. The exclusion of religious materials from libraries would amount to public "hostility" to religion, which is constitutionally disfavored.

The critical facts are that while

religious materials are and should be readily available, their use should primarily rest upon the voluntaristic personal preferences of individual students. To include religious doctrine in public school textbooks that students are required to use and in the context of state compulsory attendance legislation would raise insurmountable problems under both the Establishment Clause and the Free Exercise Clause.

Conclusion

How subjects are to be taught in the public schools, what textbooks are to be used, and how they are to be edited are low-visibility questions that traditionally have been resolved within the framework of the educational system. However, recent efforts by religious fundamentalists to win equal time for the creationist doctrine in science textbooks should remind us of the delicate, highly vulnerable First Amendment rights that are exposed in the process of selecting and editing textbooks for use in the public schools.

The constitutional implications of the creationist efforts have been considered at length. Standards have been proposed under which some of the dangers of government censorship could, it is hoped, be avoided without needlessly involving the courts in the essentially nonjusticiable matters of taste and style, on which courts lack both authority and competence. The proposed standards would allow the courts to adjudicate cases where basic constitutional rights are at stake.

The fundamentalist movement to win equal time for creation doctrine in science and biology textbooks has risen phoenixlike from the ashes of *Epperson*. It will probably be consumed once again by the Establishment Clause, although individual students may well be excused from science and biology classes, or portions thereof, under the Free Exercise rationale of *Yoder*. But the continuing problems of assuring the integrity of the vast state administrative systems, which stand astride the flow of textbooks to children in the public schools, will remain with us for a long time. Only judicial insistence on reasonably ascertainable standards of selection and appropriate procedural safeguards to secure the right of review can forestall government control of the flow of ideas that the First Amendment was intended to prohibit.

* * * * * * * * *

(Note: More than 200 legal and other citations support the quotations and statements in this article; but the citations are, in toto, too extensive for inclusion here. Lawyers and laymen who wish to see this documentation may consult the March 1974 issue of the Vanderbilt Law Review.)

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Daniel v. *Waters,* 515 F.2d 485 (6th Cir. 1975)

Judges Celebrezze, Edwards, and Lively

United States Court of Appeals for the Sixth Circuit

Plaintiffs, including the National Association of Biology Teachers, asserted that language in Chapter 377 of the 1973 Public Acts of Tennessee (popularly called the Tennessee "Genesis Law") was patently violative of the First and Fourteenth Amendments to the Constitution of the United States. The majority found in favor of the plaintiffs; the dissenting opinion was based on procedural grounds and not on the merits of the plaintiff's claims.

UNITED STATES COURT OF APPEALS FOR THE SIXTH CIRCUIT

* * * *

Appeal from the United States District Court for the Middle District of Tennessee.

* * * *

Joseph C. Daniel, Jr., Arthur W. Jones, Larry Ray Wilder, National Association of Biology Teachers, *Plaintiffs-Appellants,*

v.

Hugh Waters, Chairman, Textbook Commission of the State of Tennessee; Benjamin Carmichael, Executive Secretary of the Textbook Commission and Commissioner of Education for the State of Tennessee, Fred Stanley, Mildred Doyle, Ralph Haynes, Willie Massengill, Sidney McClain, Members of the Textbook Commission of the State of Tennessee, *Defendants-Appellees.*

* * * *

Decided and Filed, April 10, 1975

* * * *

Before: Edwards, Celebrezze and Lively, Circuit Judges.

Edwards, Circuit Judge, delivered the opinion of the Court in which Lively, Circuit Judge concurred. Celebrezze, Circuit Judge, filed a separate dissenting opinion.

Edwards, Circuit Judge. We are confronted in this appeal by a 1974 version of the legislative effort to suppress the theory of evolution which produced the famous *Scopes* "monkey trial" of 1925. *See Scopes v. State,* 154 Tenn. 105, 289 S.W. 363 (1927). In this instance the Tennessee Legislature has sought to avoid direct suppression of speech and has eschewed direct criminal sanctions. But the purpose of establishing the Biblical version of the creation of man over the Darwinian theory of the evolution of man is as clear in the 1973 statute as it was in the statute of 1925.

Plaintiffs are teachers of biology in Tennessee public schools, some of whom are also parents of public school students, plus the National Association of Biology Teachers. The defendants are members of the Tennessee state board which is charged with the responsibility of selecting public school textbooks. Jurisdiction is invoked under 28 U.S.C. Sec. 1343(3) (1970).

The statute at issue, Chapter 377 of the 1973 Public Acts of Tennessee, is reproduced below. We have underlined the specific language which plaintiffs-appellants assert to be patently violative of the First and Fourteenth Amendments to the Constitution of the United States:

SECTION 1. Tennessee Code Annotated, Section 49-2008, is amended by adding the following paragraph:

Any biology textbook used for teaching in the public schools, which expresses an opinion of, or relates a theory about origins or creation of man and his world shall be prohibited from being used as a textbook in such system unless it specifically states that it is a theory as to the origin and creation of man and his world and is not represented to be scientific fact. Any textbook so used in the public education system which expresses an opinion or relates to a theory or theories shall give in the same textbook and under the same subject commensurate attention to, and an equal amount of emphasis on, the origins and creation of man and his world as the same is recorded in other theories, including, but not limited to, the Genesis account in the Bible. The provisions of this Act shall not apply to use of any textbook now legally in use, until the beginning of the school year 1975-76; provided, however, that the textbook requirements stated above shall in no way diminish the duty of the State Textbook Commission to prepare a list of approved standard editions of textbooks for use in the public schools of the state as provided in this section. Each local school board may use textbooks or supplementary material as approved by the State Board of Education to carry out the provisions of this section. The teaching of all occult or satanical beliefs of human origin is expressly excluded from this Act.

SECTION 2. Provided, however, that the Holy Bible shall not be defined as a textbook, but is hereby declared to be a reference work and shall not be required to carry the disclaimer above provided for textbooks.

SECTION 3. The provisions of this Act are hereby declared to be severable; and if any of its sections, provisions, clauses, or parts be held unconstitutional or void, then the remainder of this Act shall continue in full force and effect, it being the legislative intent now hereby declared that this Act would have been adopted even if such unconstitutional or void matter had not been included herein.

SECTION 4. This Act shall take effect upon becoming a law, the public welfare requiring it.

1973 Tenn. Pub. Acts, Chap. 377 (Emphasis added.)

On the filing of the complaint and a motion for a preliminary injunction in this case, the District Judge, presumably because the complaint alleged the unconstitutionality of a state statute of statewide application, initiated the convening of a three-judge court. (*See* 28 U.S.C. Sec. 2281, 2284 (1970)).

The State of Tennessee then appeared and filed a motion noting that the same question was then pending in the Chancery Court of Davidson County, Tennessee. Tennessee moved that the federal court dismiss the complaint, or in the alternative, enter an order of abstention pending final state court adjudication.

Without a hearing and without reaching the merits, the three-judge court entered an order, taking notice of the state court litigation, abstaining from adjudication pending final disposition of same, but retaining jurisdiction of the case.

Plaintiff-appellants thereupon filed a jurisdictional statement seeking an appeal to the United States Supreme Court. After a Supreme Court order for a response from the State and the filing of same, the following order was entered:

> The judgment is vacated and the case is remanded to the United States District Court for the Middle District of Tennessee so that it may enter a fresh judgment from which a timely appeal may be taken to the Court of Appeals.

Although a protective appeal had previously been timely filed with this court, the three-judge District Court reentered its order of February 26, 1974, and plaintiffs-appellants have filed notice of appeal, which appeal has now been briefed and argued before this court.

The parties have advised that on Spetember 9, 1974, the Chancery Court of Davidson County, Tennessee, decided the case before it on the merits, holding that the statute attacked was in violation of the First and Fourteenth Amendments. The State has appealed, thereby suspending the effectiveness of the Circuit Court decree until the Supreme Court of Tennessee decides the case.

ABSTENTION

Abstention is an appropriate response to a federal complaint alleging unconstitutionality of a state statute where state interpretation of its own ambiguous statute might serve to render it inoffensive to the federal Constitution. *Lake Carriers' Ass'n. v. MacMullan,* 406 U.S. 498 (1972).

The federal courts are not permitted otherwise, however, to shut their doors to a complaint of federal constitutional violation even if there is a possible state remedy which is being pursued. *Home Telephone & Telegraph Co.* v. *City of Los Angeles,* 227 U.S. 278 (1913); *Kaspar* v. *Pontikes,* 414 U.S. 51 (1973); *Harman* v. *Forssenius,* 380 U.S. 528 (1965). In this last case the Supreme Court said:

> If the state statute in question, although never interpreted by a state tribunal, is not fairly subject to an interpretation which will render unnecessary or substantially modify the federal constitutional question, it is the duty of the federal court to exercise its properly invoked jurisdiction. *Baggett* v. *Bullitt,* 377 U.S. 360, 375-379. Thus, "recognition of the role of state courts as the final expositors of state law implies no disregard for the primacy of the federal judiciary in deciding questions of federal law." *England* v. *Louisiana State Board of Medical Examiners,* 375 U.S. 411, 415-416.

With these principles in mind, we turn to an examination of the statute itself against the federal constitutional principles which are relied upon.

THE FIRST AMENDMENT

The First Amendment to the Constitution of the United States says in applicable part:

> Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof;...

The Fourteenth Amendment to the Constitution of the United States says in applicable part:

> No State shall make or enforce any law which shall abridge the privileges or immunities of citizens of the United States; nor shall any State deprive any person of life, liberty, or property, without due process of law; nor deny to any person within its jurisdiction the

equal protection of the laws. U.S. Const. amend XVI, Sec. 1.

We have previously indicated that the statute complained of does not directly forbid the teaching of evolution. It does, however, prohibit the selection of any textbook which teaches evolution unless it also contains a disclaimer stating that such doctrine is "a theory as to the origin and creation of man and his world and is not represented to be scientific fact." And the same statute expressly requires the inclusion of the Genesis version of creation (if any version at all is taught) while permitting that version alone to be printed without the above disclaimer. (Section 2 of the statute quoted above says: "Provided, however, that the Holy Bible shall not be defined as a textbook, but is hereby declared to be a reference work and shall not be required to carry the disclaimer above provided for textbooks.") Furthermore, "the teaching of all occult or satanical beliefs of human origin is expressly excluded from this Act," presumably meaning that religious beliefs deemed "occult" or "satanical" need not be printed in biology texts along with the other theories.

We believe that in several respects the statute under consideration is unconstitutional on its face, that no state court interpretation of it can save it, and that in this case, the District Court clearly erred in abstaining from rendering a determination of the unconstitutionality of the statute on its face.

First, the statute requires that any textbook which expresses an opinion about the origin of man "shall be prohibited from being used" unless the book specifically states that the opinion is "a theory" and "is not represented to be scientific fact." The statute also requires that the Biblical account of creation (and with other theories of creation) be printed at the same time, with commensurate attention and equal emphasis. As to all such theories, except only the Genesis theory, the textbook must print the disclaimer quoted above. But the proviso in Section 2 would allow the printing of the Biblical account of creation as set forth in Genesis without any such disclaimer. The result of this legislation is a clearly defined preferential position for the Biblical version of creation as opposed to any account of the development of man based on scientific research and reasoning. For a state to seek to enforce such a preference by law is to seek to accomplish the very establishment of religion which the First Amendment to the Constitution of the United States squarely forbids.

We believe the provisions of the Tennessee statute are obviously in violation of the First Amendment prohibition on any law "respecting the establishment of religion" as that phrase has been authoritatively interpreted in *Epperson* v. *Arkansas,* 393 U.S. 97 (1968), and *Lemon* v. *Kurtzman,* 403 U.S. 602 (1971).

In *Epperson* the Supreme Court said:

> In any event, we do not rest our decision upon the asserted vagueness of the statute. On either interpretation of its language, Arkansas' statute cannot stand. It is of no moment whether the law is deemed to prohibit mention of Darwin's theory, or to forbid any or all of the infinite varieties of communication embraced within the term "teaching." Under either interpretation, the law must be stricken because of its conflict with the constitutional prohibition of state laws respecting an establishment of religion or prohibiting the free exercise thereof. The overriding fact is that Arkansas' law selects from the body of knowledge a particular segment which it proscribes for the sole reason that it is deemed to conflict with a particular religious doctrine; that is, with a

particular interpretation of the Book of Genesis by a particular religious group.

The antecedents of today's decision are many and unmistakable. They are rooted in the foundation soil of our Nation. They are fundamental to freedom.

Government in our democracy, state and national, must be neutral in matters of religious theory, doctrine, and practice. It may not be hostile to any religion or to the advocacy of no-religion; and it may not aid, foster, or promote one religion or religious theory against another or even against the militant opposite. The First Amendment mandates governmental neutrality between religion and religion, and between religion and nonreligion.

As early as 1872, this Court said: "The law knows no heresy, and is committed to the support of no dogma, the establishment of no sect." *Watson* v. *Jones,* 13 Wall. 679. 728. This has been the interpretation of the great First Amendment which this Court has applied in the many and subtle problems which the ferment of our national life has presented for decision within the Amendment's broad command.

Judicial interposition in the operation of the public school system of the Nation raises problems requiring care and restraint. Our courts, however, have not failed to applv the First Amendment's mandate in our educational system where essential to safeguard the fundamental values of freedom of speech and inquiry and of belief. By and large, public education in our Nation is committed to the control of state and local authorities. Courts do not and cannot intervene in the resolution of conflicts which arise in the daily operation of school systems and which do not directly and sharply implicate basic constitutional values. On the other hand, "[t]he vigilant protection of constitutional freedoms is nowhere more vital than in the community of American schools." *Shelton* v. *Tucker,* 364 U.S. 479, 487 (1960). As this Court said in *Keyishian* v. *Board of Regents,* the First Amendment "does not tolerate laws that cast a pall of orthodoxy over the classroom." 385 U.S. 589, 603 (1967).

There is and can be no doubt that the First Amendment does not permit the State to require that teaching and learning must be tailored to the principles or prohibitions of any religious sect or dogma. In *Everson* v. *Board of Education,* this Court, in upholding a state law to provide free bus service to school children, including those attending parochial schools, said: "Neither [a State nor the Federal Government] can pass laws which aid one religion, aid all religions, or prefer one religion over another." 330 U.S. 1, 15 (1947).

At the following Term of Court, in *McCollum* v. *Board of Education,* 333 U. S. 203 (1948), the Court held that Illinois could not release pupils from class to attend classes of instruction in the school buildings in the religion of their choice. This, it said, would involve the State in using tax-supported property for religious purposes, thereby breaching the "wall of separation" which, according to Jefferson, the First Amendment was intended to erect between church and state. *Id.,* at 211. See also *Engel* v. *Vitale,* 370 U.S. 421 (1962); *Abington School District* v. *Schempp,* 374 U.S. 203 (1963). While study of religions and of the Bible from a literary and historic viewpoint, presented objectively as part of a secular program of education, need not collide with the First Amendment's prohibition, the State may not adopt programs or practices in its public schools or colleges which "aid or oppose" any religion. *Id.,* at 225. This prohibition is absolute. *It forbids alike the preference of a religious doctrine or the prohibition of theory which is deemed antagonistic to a particular dogma.* As Mr. Justice Clark stated in *Joseph Burstyn, Inc.* v. *Wilson,* "the state has no legitimate interest in protecting any or all religions from views distasteful to them...." 343 U.S. 495, 505 (1952). The test was stated as follows in *Abington School District* v. *Schempp, supra,* at 222: "[W]hat are the purpose and the primary effect of the enactment? If either is the advancement or inhibition of religion then the enactment exceeds the scope of legislative power as circumscribed by the Constitution." *Epperson* v. *Arkansas* 393 U.S. 97, 103-05, 106-07 (1968). (Emphasis added.) (Footnotes omitted.)

In *Lemon* Chief Justice Burger said: In the absence of precisely stated constitutional prohibitions, we must draw lines with reference to the three main evils against which the Establishment Clause was intended to afford protection: "sponsorship, financial, support, and active involvement of the sovereign in religious activity." *Walz* v. *Tax Commission,* 397 U. S. 664, 668 (1970).

Every analysis in this area must begin with consideration of the cumulative criteria developed by the Court over many years. Three such tests may be gleaned from our cases. First, the statute must have a secular legislative purpose; second, its principal or primary effect must be one that neither advances nor inhibits religion, *Board of Education* v. *Allen,* 392 U.S. 236, 243 (1968); finally, the statute must not foster "an excessive government entanglement with religion." *Walz, supra,* at 674. *Lemon* v. *Kurtzman,* 403 U.S. 602, 612-13 (1971).

While the requirement of preferential treatment of the Bible clearly offends the Establishment Clause of the First Amendment, the exclusion at the end of Section 1 of the statute would inextricably involve the state Textbook Commission in the most difficult and hotly disputed of theological arguments in direct conflict with Chief Justice Burger's third standard. Throughout human history the God of some men has frequently been regarded as the Devil incarnate by men of other religious persuasions. It would be utterly impossible for the Tennessee Textbook Commission to determine which religious theories were "occult" or "satanical" without seeking to resolve the theological arguments which have embroiled and frustrated theologians through the ages. (Footnote: See "Satan" and "satanical," 9 Oxford Eng. Dict. 116 (1933), and W. Woods, A History Of The Devil (1973) to note how frequently differences of religious opinions are accompanied by denunciation employing the terms "Satan" or "the Devil.").

The requirement that some religious concepts of creation, adhered to presumably by some Tennessee citizens, be excluded on such grounds in favor of the Bible of the Jews and the Christains represents still another method of preferential treatment of particular faiths by state law and, of course, is forbidden by the Establishment Clause of the First Amendment.

We deem the two constitutional violations described above to be patent and obvious on the face of the statute and impossible for any state interpretation to cure. Under these circumstances, we find no need to determine whether the terms "occult" and "satanical" are, as claimed by appellants, also void for vagueness under the Due Process Clause of the Fourteenth Amendment. Nor for the same reason do we feel it is necessary or desirable to pass on appellants' claims that the statute as drawn represents violation of the Freedom of Speech and Press Clauses of the First Amendment.

RELIEF

We have examined with interest the order entered by the Supreme Court, along with the jurisdictional statement filed by Tennessee in the Supreme Court and the response thereto filed by the plaintiffs. We believe that the order can properly be interpreted as indication that no three-judge District Court was necessary in this action under 28 U.S.C. Sec. 2281 (1970) because, as we have determined above, this state statute is patently unconstitutional. *See Bailey* v. *Patterson*, 369 U.S. 31 (1962), and *Turner* v. *City of Memphis*, 369 U.S. 350 (1962).

We particularly note the similarity between the language vacating and remanding employed by the Supreme Court in *Pennsylvania Public Utility Commission* v. *Pennsylvania Railroad Co.*, 382 U.S. 281 (1965), and the order entered in this case.

It may, however, be argued (as does the dissent) that the Supreme Court lacked jurisdiction over a direct appeal from the order of abstention entered by the three-judge court in this case because the order was interlocutory and not one granting or denying preliminary injunctive relief. *See, e.g., MTM, Inc.* v. *Baxley*, 43 U.S.L.W. 4442 (U.S. March 25, 1975); *Gonzalez* v. *Automatic Employees Credit Union*, 43 U.S.L.W. 4025 (U.S. December 10, 1974); *Goldstein* v. *Cox*, 396 U.S. 471 (1970); *Rockefeller* v. *Catholic Medical Center*, 397 U.S. 820 (1970). As we see the matter, however, the abstention order did in effect deny preliminary injunctive relief and effectively shut the federal courthouse door upon plaintiffs in their search for timely vindication of their federal constitutional claims.

Such a denial of federal adjudication is peculiarly inappropriate when the constitutional claim rests upon the First Amendment to the United States Constitution. In a First Amendment case the United States Supreme Court noted:

> In such a case to force the plaintiff who has commenced a federal action to suffer the delay of state court proceedings might itself effect the impermissible chilling of the very constitutional right he seeks to protect. *See Dombrowski* v. *Pfister*, 380 U.S. 479, 486-487; *Baggett* v. *Bullitt*, *supra*, at 3780379 [377 U.S. 360 1964)]; *NAACP* v. *Button*, *supra*, at 433 [371 U.S. 415 (1963)]; *Cf. Garrison* v. *Louisiana*, 379 U.S. 64, 74-75; *Smith* v. *California*, 361 U.S. 147. *Zwickler* v. *Koota*, 389 U.S. 241, 252 (1967).

The judgments of the District Court are vacated and the case is remanded for entry of an order dissolving the three-judge court and an order by the District Judge before whom the case was filed granting preliminary injunctive relief in accordance with this opinion.

* * * *

Celebrezze, Circuit Judge (dissenting).

I respectfully dissent because I do not interpret the Supreme Court's remand order as a holding that Tennessee's biology textbook law is patently unconstitutional. The Supreme Court's order was as follows:

> The judgment is vacated and the case is remanded to the United States District Court for the Middle District of Tennessee so that it may enter a fresh judgment from which a timely appeal may be taken to the Court of Appeals.

This is not a holding that "no three-judge District Court was necessary....because this state statute is patently unconstitutional," as the majority interprets the remand order. Had the Supreme Court meant that, it would have said so and would have remanded "to the District Court with direction to enter a decree granting appropriate injunctive relief," as it did in *Turner* v. *City of Memphis*, 369 U.S. 350, 354 (1962), and *Bailey* v. *Patterson*, 369 U.S. 31, 34 (1962), the cases the majority cites in support of its view. Furthermore, if this view of the Supreme Court's order is valid, the majority's discussion of the merits of the Tennessee statute is pure surplusage.

I believe that the proper interpretation of the Supreme Court's remand order is that this Court, rather than the Supreme Court, should review the merits of the three-judge District Court's abstention order. Under 28 U.S.C. Sec. 1253 (1966), the Supreme Court does not have jurisdiction to review abstention orders of three-judge district courts which do not grant or deny interlocutory or permanent injunctive relief. Section 1253 allows a party to appeal an order from a three-judge district court to the Supreme Court only if it is an "order granting or denying...an interlocutory or permanent injunction." The abstention order appealed from does not grant or deny injunctive relief; it merely postpones decision, without dismissing the complaint. Thus, this case is within a growing line of decisions where the Supreme Court has denied its jurisdiction over appeals from orders of three-judge district courts. *See Gonzales* v. *Automatic Employees Credit Union,* --- U.S. ---, 43 U.S.L.W. 4025 (Dec. 10, 1974); *McCann* v. *Babbitz,* 400 U.S. 1 (1970); *Gunn* v. *University Committee,* 399 U.S. 383 (1970); *Mitchell* v. *Donovan,* 398 U.S. 427 (1970); *Rockefeller* v. *Catholic Medical Center,* 397 U.S. 820 (1970); *Wilson* v. *City of Port Lavaca,* 391 U.S. 352 (1968). *See also Thomas* v. *Heffernan,* 473 F.2d 478 (2d Cir. 1973), *rev'd on other grounds,* 94 S. Ct. 3199 (1974).

The appeal falls within the rule announced in *Goldstein* v. *Cox,* 396 U. S. 471 (1970), that an order of a three-judge district court which falls short of adjudicating the constitutional merits of a challenged statute and does not grant or deny *preliminary* injunctive relief is not appealable to the Supreme Court. Rather, the relevant Court of Appeals must review the appeal's merits. *See also Hutcherson* v. *Lehtin,* 399 U.S. 522 (1970), where the Supreme Court remanded for consideration by the Ninth Circuit of an appeal of a three-judge district court order which had abstained from considering one aspect of the plaintiff's constitutional attack on a state statute (313 F.Supp. 1324 (N.D.Cal. 1970). Here the District Court took no action on Appellant's motion for preliminary and permanent injunctive relief, so that *Goldstein* v. *Cox* required the Supreme Court to remand the appeal to this Court. (Footnote: It would have been desirable for the Supreme Court to have explained its action more fully. This appears to be the first instance where the Supreme Court has declined jurisdiction over an appeal of an abstention order of a three-judge district court. The *Hutcherson* case involved abstention in part but also concerned other rulings by the district court. While this opinion was at the printer's, the Supreme Court held in *MTM, Inc.* v. *Baxley,* No. 73-1119 (March 25, 1975), that "a direct appeal will lie to this Court under Sec. 1253 from the order of a three-judge federal court denying interlocutory or permanent injunctive relief only where such order rests upon resolution of the merits of the constitutional claim presented below." This holding makes crystal clear that we, rather than the Supreme Court, have juristiction to hear the appeal of the three-judge court's abstention order.)

I do not believe that we are in a procedural quagmire, as the majority suggests exists. The Supreme Court simply directed that this Court, rather than itself, hear the appeal of the abstention order. We should do so. (Footnote: An abstention order is appealable to this Court under 28 U.S.C. Sec. 1291 (1966). *Idlewild Liquor Corp.* v. *Epstein,* 370 U.S. 713, 715 n. 2 (1962); *Druker* v. *Sullivan,* 458 F.2d 1272, 1274 n.3 (1st Cir. 1972). We have no jurisdiction over this appeal from a three-judge district court because its order is not appealable directly to the Supreme Court. Section 1291 extends our jurisdiction to all district court appeals "except where a direct review may be had in the Supreme Court.").

Having jurisdiction over the abstention order's validity, we might rest our decision on a ground not briefed or argued by the parties--that the three-judge district court should have held that the case involves "no substantial constitutional claim," and therefore should have dissolved itself for want of jurisdiction under 28 U.S.C. Sec. 2281 (1966). Had this happened, the single district judge would have entered appropriate relief based on the holding that the Tennessee statute is patently unconstitutional on its face. This is the ground on which the majority rests its decision.

I cannot concur. The constitutional issue in this case is not "wholly insubstantial" for the purpose of determining whether a three-judge district court is necessary under Sec. 2281.

A reading of *Goosby* v. *Osser,* 409 U.S. 512 (1973), reveals a strict standard for refusing to convene a three-judge district court on the ground that the constitutional issue involved is insubstantial. (Footnote: *Goosby* has caused other circuits to restrict dismissals of complaints by single-judge district courts on the ground that constitutional issues are insubstantial. *See, e.g., Roe* v. *Ingraham,* 480 F.2d 102 (2d Cir. 1973) (reversing dismissal of complaint and remanding for three-judge court consideration, citing the "strict test" of *Goosby*). Contrast the pre-*Goosby* decision in *Johnson* v. *New York State Education Department,* 449 F.2d 871 (2d Cir. 1971) (with strong dissent), *vacated,* 409 U.S. 75 (1972). Likewise, the Third Circuit, whose *Goosby* decision, 452 F.2d 39 (3d Cir. 1971), was reversed, has recognized that the Supreme Court "has interpreted the requirement for a substantial federal question liberally" since *Goosby*. *Farley* v. *Farley,* 481 F.2d 1009, 1011 (3d Cir. 1973); *Rowland* v. *Tarr,* 480 F.2d 545 (3d Cir. 1973).)

In *Goosby,* the Supreme Court unanimously held:

> Title 28 U.S.C. Sec. 2281 does not require the convening of a three-judge court when the constitutional attack upon the state statutes is insubstantial. "Constitutional insubstantiality" for this purpose has been equated with such concepts as "essentially fictitious," *Bailey* v. *Patterson,* 369 U.S., at 33; "wholly insubstantial," *ibid.;* "obviously frivolous," *Hannis Distilling Co.* v. *Baltimore,* 216 U.S. 285, 288 (1910); and "obviously without merit," *Ex parte Poresky,* 290 U.S. 30, 32 (1933). The limiting words "wholly" and "obviously" have cogent legal significance. In the context of the effect of prior decisions upon the substantiality of constitutional claims, those words import that claims are constitutionally insubstantial only if the prior decisions inescapably render the claims frivolous; previous decisions that merely render claims of doubtful or questionable merit do not render them insubstantial for the purposes of 28 U.S.C. Sec. 2281. A claim is insubstantial only if "its unsoundness so clearly results from the previous decisions of this court as to foreclose the subject and leave no room for the inference that the questions sought to be raised can be the subject of controversy." 409 U.S. at 518.

The *Goosby* plaintiffs had attacked as unconstitutional a Pennsylvania statute which allegedly prohibited persons jailed before trial from voting. The Third Circuit affirmed the dismissal of the complaint by a single district judge, citing *McDonald* v. *Board of Election Comm'rs,* 394 U.S. 802 (1969), where the Supreme Court had upheld the constitutionality of an Illinois statute denying absentee ballots to pretrial detainees. The Supreme Court reversed the Third Circuit, holding that *McDonald* merely upheld the right of a state to limit access to its absentee ballot procedures. The *Goosby* complaint alleged that Pennsylvania pretrial detainees were *absolutely* prevented from voting. This was a different case, said the

Supreme Court, at least for the purpose of determining whether a three-judge court should have been convened.

The Tennessee biology textbook statute is different from the laws challenged in *Epperson* v. *Arkansas,* 393 U.S. 97 (1968), and *Lemon* v. *Kurtzman,* 403 U.S. 602 (1971), contrary to the holding of the majority. *Epperson* overturned a statute which made it unlawful for a publicly employed teacher to teach the theory of Darwinian evolution. The Tennessee statute, by contrast, contains no criminal sanctions and prescribes that religious theories of evolution and the creation *be included* in the teaching of biology. Thus, it cannot be said that *Epperson* "leave[s] no room for the inference that the question sought to be raised [by Appellees] can be the subject of controversy." *Goosby,* 409 U.S. at 519.

Likewise, *Lemon* v. *Kurtzman* does not foreclose inquiry into Appellee's defense of the Tennessee statute. *Lemon,* itself a case provoking five separate opinions, struck down certain state statutes authorizing the expenditure of public funds for particular kinds of support to nonpublic schools. As this Court held in *Protestants and Other Americans United* v. *United States,* 435 F.2d 627 (6th Cir. 1970), *cert. denied,* 402 U.S. 974 (1971):

> The decisions of the Supreme Court construing the Free Exercise and Establishment Clauses of the First Amendment have drawn fine distinctions and have laid down rules not easy to apply. They have been decisions by divided courts. 435 F.2d at 630.

Accordingly, we held in *Protestants* that a substantial question was presented by a complaint and that a three-judge district court should have been convened to consider it. The complaint attacked the constitutionality of a federal statute which authorized "the loaning of library books and materials directly to the parochial schools, rather than the issuing of textbooks directly to the school children," the latter procedure having been upheld in *Board of Education of Central School District No. 1* v. *Allen,* 392 U.S. 236 (1968).

It is impossible satisfactorily to reconcile our holding in *Protestants* with the decision here. *See also Anderson* v. *Richardson,* 454 F.2d 596 (6th Cir. 1972). Like *Epperson, Lemon* does not foreclose all argument that the Tennessee statute, or a part thereof, is constitutional, at least within the strict test set forth in *Goosby.* The "establishment" and "entanglement" issues are not "fictitious" or "frivolous." They deserve consideration by a three-judge district court. They warrant more than the cursory briefing and argument which the parties gave them on this appeal, since the basic issues briefed before us were those of jurisdiction and abstention. Indeed, the three-judge District Court itself, which had the benefit of briefing, stated that is was not "persuaded that the [statute] is clearly lacking in constitutional validity."

The majority's decision not only violates the rule set forth in *Goosby,* but it does not accord with the basic Congressional purpose behind the three-judge court statutes. That purpose was succinctly stated by Mr. Justice Frankfurter in *Phillips* v. *United States,* 312 U.S. 246, 251 (1941):

> The crux of the business is procedural protection against an improvident state-wide doom by a federal court of a state's legislative policy.

Through the three-judge district court procedure Congress intended to limit the power of single district judges to enjoin the operation of state laws. (Footnote: For a discussion of the history of the three-judge court statutes, *see* C. Wright, Federal Courts Sec. 50 (1963); Hutcheson, "A Case for Three Judges," 47 Harv. L. Rev. 795 (1934). The resentment which action by single judges had engendered before the enactment of section 2281 is evident in the remarks of Senator Overman of North Carolina during the debates on that section: "I saw in Moody's Magazine last week that there are 159 cases of this kind now where one federal judge has tied the hands of the state officers, the governor, and the attorney general... My experience is that the state is sometimes delayed a solid year in collecting taxes...Whenever one judge stands up in a State and enjoins the governor and the attorney general, the people resent it, and public sentiment is stirred, as it was in my State, and you find the people of the State rising up in rebellion." 45 Cong. Rec. 7256 (1910).

In *Goosby*, the single judge's decision had been to dismiss the complaint, thus not infringing the basic purpose behind section 2281. Its decision was nonetheless reversed.

Here, however, the majority orders a single judge to enjoin the operation of a statute. The law may or may not require that the Tennessee statute not be enforced. The law does require that a three-judge district court be convened to make that determination. A three-judge court determination is needed "to allow a more authoritative determination and less opportunity for individual predilection in sensitive and politically emotional areas." *Swift & co.* v. *Wickham*, 382 U.S. 111, 119 (1965). *Cf. Potter* v. *Meier*, 458 F.2d 585, 588-89 (8th Cir. 1972). Given the slightest room for argument that prior decisions of the Supreme Court do not foreclose the possibility that the Tennessee statute, or a part thereof, is constitutional, the three-judge district court should have been allowed to determine its validity. (Footnote: The majority's decision leaves substantial doubt as to exactly what parts of the Tennessee statute are unconstitutional. The majority finds that the proviso in section 2 which excepts the Holy Bible from the requirement that accounts of the creation carry disclaimers of scientific accuracy violates the establishment clause of the First Amendment. The statement at the end of section 1 that "the teaching of all occult or satanical beliefs of human origins" need not be included in biology textbooks is found condemned by the "excessive entanglement" principle. With these two items removed from the statute, the majority's opinion gives no guidance to the single judge who is instructed to grant "preliminary injunctive relief in accordance with this opinion." Whether he is to enjoin operation of the entire statute or to prohibit particular actions based on particular objectionable sections is unclear. This is true despite a severability clause in the Tennessee statute which leaves operable any provision which is not held to be unconstitutional.)

I have found only a handful of cases where the Supreme Court or a Circuit Court has affirmed or ordered the entry of injunctive relief against the operation of a state law by a single district judge on the ground that the statute lacked even a colorable claim of constitutional validity (the *Bailey* principle).

The most prominent instance involves state laws mandating racial segregation, in the face of Supreme Court decisions which "foreclosed as a litigable issue" the validity of segregative statutes. *Bailey* v. *Patterson*, 369 U.S. 31, 33 (1962); *City of New Orleans* v. *Barthe*, 376 U.S. 189 (1964); *Turner* v. *City of Memphis*, 369 U.S. 350 (1962); *Evers* v. *Jackson Municipal Separate School District*, 328 F.2d 408 (5th Cir. 1964); *Simkins* v. *Moses H. Cone Memorial Hospital*, 323 F.2d 959 (4th Cir. 1963); *City of New Orleans* v. *Adams*, 321 F.2d 493 (5th Cir. 1963); *United States* v. *City of Jackson*, 318 F.2d 1 (5th Cir. 1963); *Potts* v. *Flax*, 313 F.2d 284 (5th Cir. 1963); *Meredith* v. *Fair*, 305 F.2d 343 (5th Cir.), *cert. denied*, 371 U.S. 828 (1962); *Christian* v. *Jemison*, 303 F.2d 52 (5th Cir. 1962).

A second use of the *Bailey* principle occurred in *Alabama Civil Liberties Union* v. *Wallace*, 456 F.2d 1069 (5th

Cir. 1972), where the Fifth Circuit affirmed an injunction issued by a single district judge against enforcement of a statute requiring Bible reading in the public schools, in explicit contravention of *School District of Abington* v. *Schemp,* 374 U.S. 203 (1963).

A third instance involved the reversal of a single judge's denial of relief from the operation of a statute making it a misdeameanor to print or circulate "any notice...that a boycott or ban exists or has existed or is contemplated against any person, firm, corporation, or association of persons doing a lawful business." The Fifth Circuit found "legion" support for its decision that the statute was overbroad on its face and cited *Thornhill* v. *State of Alabama,* 310 U.S. 88 (1940), which had held a nearly identical companion statute unconstitutionally vague. *Kirkland* v. *Wallace,* 403 F.2d 413 (5th Cir. 1968). The decision provoked a strong dissent. 403 F.2d at 417-25.

The fourth and only other use of the *Bailey* principle by a Circuit Court involved an attack on Arizona's vagrancy statute. The Ninth Circuit held that *Papachristou* v. *City of Jacksonville,* 405 U.S. 156 (1972), which had overturned a nearly identical vagrancy law, governed the case. *Anderson* v. *Nemetz,* 474 F.2d 814 (9th Cir. 1973). The Ninth Circuit pointed out that the state defendants conceded that the statute was constitutionally indefensible and were merely contesting standing and absention issues.

None of these cases supports the majority. The *Bailey* principle was meant to be confined to instances where the defense of a statute would raise only "frivolous" or "fictitious" constitutional arguments. *Gong* v. *Kirk,* 375 F.2d 728, 729 n. 2 (5th Cir. 1967); *Trombetta* v. *State of Florida,* 339 F. Supp. 1359, 1362 (M.D.Fla. 1972). Professor Currie, whose article "The Three-Judge District Court in Constitutional Litigation," 32 U. Chi. L. Rev. 1 (1964), remains the classic work on the subject, warned that "the [*Bailey*] principle is a volatile one that could easily get out of control. (Footnote: 32 U. Chi. L. Rev. at 66. *See also* Note, "The Three-Judge District Court: Scope and Procedure under Section 2281" 77 Harv. L. Rev. 299, 315 (1963).)

This Circuit has previously noted the drain placed on judicial resources by the three-judge court statutes. *Jones* v. *Branigin,* 433 F.2d 576 (6th Cir. 1970), *cert. denied,* 401 U.S. 977 (1971). But this Circuit has always followed procedures mandated by Congress. *See Protestants, supra; Anderson* v. *Richardson,* 454 F.2d 596 (6th Cir. 1972). The three-judge court procedures sometimes lead to futile procedural remands and to consideration by three judges of issues a single judge can easily decide. *See Farley* v. *Farley,* 481 F.2d 1009, 1012 (3rd Cir. 1973). The remedy, however, is up to Congress. I would apply section 2281 in its present form and under its current interpretation by the Supreme Court. I would not order the process Congress has mandated for this case to be short-circuited in the manner the majority prescribes.

Because I am in dissent, there is no need to explain in depth my view of the basic issue presented by this appeal -- whether the District Court erred in abstaining from decision on the merits of Appellants' claims. Simply stated, my position is that the District Court erred in abstaining because no state court construction of state law could avoid ultimate decision of the constitutional issues presented by the Tennessee statute. However narrowly the Tennessee Supreme Court might confine the statute's reach, its basic thrust must remain. Its central core is review by the Tennessee Textbook Commission to see that biology textbooks carry scientific disclaimers as to any particular theory of creation and evolution and that biology textbooks contain religious accounts of the creation and evolution. Whether the entanglement that must result between government and religion will exceed the permissible degree is a question that must ultimately be faced. *See Protestants,* 435 F.2d at 630.

Abstention is therefore improper. *Harman* v. *Forssenius,* 380 U.S. 528, 534035 (1965); *Baggett* v. *Bullitt,* 377 U.S. 360, 375-79 (1964). The fact that a state constitutional provision might also decide the case does not warrant abstention, because the state provision here is substantially similar to the federal First Amendment. *Carden* v. *Bland,* 199 Tenn. 665, 672, 288 S.W.2d 718 (1956). *Wisconsin* v. *Constantineau,* 400 U.S. 433 (1971).

The case on which the District Court relied to justify abstention, *Reetz* v. *Bozanich,* 397 U.S. 82 (1970, does not apply to this dispute. In *Reetz* the basic issue concerned management of natural resources, which the Supreme Court stated was "a matter of great state concern." 397 U.S. at 87. Furthermore, the Supreme Court held that the Alaskan Constitution, which deals in detail with fishery rights and private interests, might be "the nub of the whole controversy." 397 U.S. at 87. Thus, *Reetz* is a far different case from ours, where the challenged state statute is attacked on essentially one ground -- conflict with the constitutional clause guaranteeing freedom of exercise and freedom from establishment of religion.

The District Court should have proceeded to adjudicate Appellants' claim on the merits.

Were this Court to reverse the abstention order, it could only remand for consideration of the merits of the statute by the three-judge District Court. As the Supreme Court held in *Goosby,* 409 U.S. at 522 n. 8, once it is determined that a claim is properly one for a three-judge court to decide, the jurisdiction of the Court of Appeals ends. We are without jurisdiction to consider the merits of Appellants' constitutional contentions, and I intimate no view about them.

In summary, I believe that the Supreme Court's remand order meant only one thing--that this Court should decide the merits of the District Court's abstention order. The constitutional issues concerning the Tennessee statute are not "frivolous" or "fictitious." They merit consideration by a three-judge district court, as required by 28 U.S.C. Sec. 2281. The District Court should not have abstained, but should have promptly adjudicated Appellants' claim. Thus, we should reverse the District Court's order and remand for consideration of the merits of the Tennessee statute. We have no jurisdiction to decide the constitutional issues ourselves.

25-26

Tennessee "Genesis Law" Ruled Unconstitutional

Jerry P. Lightner

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In April 1973 the Tennessee General Assembly amended its State Code Annotated, Section 49-2008 thus requiring biology textbooks to provide "an equal amount of emphasis on the origins and creation of man...as recorded in...the Genesis account in the Bible." Here is a review of the events which occurred between December 28, 1973 and April 10, 1975 during the process of federal court litigation which resulted in a decision that the law was unconstitutional.

The attempt by the National Association of Biology Teachers to obtain a federal court judgment against the Tennessee "Genesis Law" ended successfully on April 10, 1975 when the United States Court of Appeals for the Sixth Circuit ruled the Tennessee law unconstitutionally established a preference for the teaching of the biblical account of creation over the theory of evolution. The Court called the case a new version of "the legislative effort to suppress the theory of evolution which produced the famous Scopes Monkey Trial of 1925."

The Appeal Court ruled that the result of the Tennessee legislation was "a clearly defined preferential position for the Biblical version of creation as opposed to any account of the development of man based on scientific research and reasoning. For a state to seek to enforce such a preference by law is to seek to accomplish the very establishment of religion which the First Amendment to the Constitution of the United States squarely forbids." The Court also stated that the law was unconstitutional in other respects, and that "the District Court clearly erred in abstaining from rendering a determination of the unconstitutionality of the statute on its face." Judges George Edwards and Pierce Lively voted in the majority; Judge Anthony Celebrezze dissented on procedural grounds saying he believed the federal District Court in Tennessee should have heard the case.

Tennessee Governor Ray Blanton said the decision "saves me from administering a law I did not believe in anyway. I don't believe a legislative or executive branch should get into the setting of curriculum for public schools."

The action overturned legislation passed by the Tennessee General Assembly in April of 1973 which amended Tennessee's Code Annotated, Section 49-2008. The legislation stated: "Any biology textbook used for teaching in the public schools, which expresses an opinion of, or related a theory about origins or creation of man and his world shall be prohibited from being used as a textbook in such system unless it states that it is a theory as to the origin and creation of man and his world and is not represented to be scientific fact. Any textbook so used in the public education system which expresses an opinion or relates to a theory or theories shall give in the same textbook and under the same subject commensurate attention to, and an equal amount of emphasis on, the origins and creation of man and his world as the same is recorded in other theories, including, but not limited to, the Genesis account in the Bible" The act also stated that "the Holy Bible shall not be defined as a textbook but is hereby declared to be a reference book."

At its meeting on June 15-16, 1973, the NABT Board of Directors unanimously moved to assume the role of plaintiff against the State of Tennessee in litigation challenging the constitutionality of the new "Genesis Law." On October 11, 1973 NABT formally retained Frederic S. LeClercq, attorney at law and associate professor of law at the University of Tennessee, and instructed him to initiate a lawsuit as early as possible. Three coplaintiffs were named: Joseph Daniel, Jr., Arthur Jones, and Larry Ray Wilder. Daniel and Jones are professors of zoology at the University of Tennessee and Wilder is a teacher in the Knoxville public schools. The suit was filed on December 28, 1973 in the United States District Court for the Middle District of Tennessee, and appellant's motion to convene a three judge court was granted.

NABT's suit maintained that the Tennessee law was an establishment of religion by the state in violation of the Due Process Clause of the Fourteenth Amendment, that it interferred with the Free Exercise of Religion as that guarantee is incorporated by the Due Process Clause, that it abridged the Free Speech Clause of the First Amendment as that clause is incorporated by the Due Process Clause, that it was a prior restraint upon the Freedom of Press in violation of the Due Proceys Clause as it incorporates the Free Press Clause of the First Amendment, and that it was void for vagueness in violation of the Due Process Clause.

On February 5, 1974 the State of Tennessee, through its assistant attorney general, filed a motion in the United States District Court asking for dismissal of NABT's suit, contending that NABT and its co-plaintiffs lacked standing and failed to state a claim upon which relief could be granted. Furthermore, if dismissal could not be granted, the motion asked for abstention of the District Court pending determination of State constitutional issues raised by a suit filed by Americans United for Separation of Church and State. The AUSCS suit had been filed February 1, 1974 in the Chancery Court of Davidson County, Nashville, Tennessee. On March 5, 1974 NABT filed a motion to intervene, a complaint, and an order in the AUSCS suit, but expressly reserved its federal constitutional claims for Federal determination.

A trial brief opposing the motion to dismiss was immediately prepared by Le Clercq and filed on February 10, 1974. NABT's brief argued that the Association did have standing in Tennessee to sue, that there was no justification for the federal court to abstain, and that the Tennessee law was not susceptible of any saving construction which would avoid the federal constitutional question. On February 26, 1974 a unanimous *per curiam* order was filed by the United States District Court abstaining from deciding upon NABT's federal constitutional claims but retaining jurisdiction pending the completion of state court proceedings.

In response to the *per curiam* order of the District Court, NABT appealed to the Supreme Court of the United States. The notice of appeal, filed March 6, 1974 raised two questions; first, should the District Court have abstained pending proceedings in the State Court without passing upon the merits of NABT's claims that the Tennessee law was repugnant to the Constitution of the United States, and second, was the Tennessee law repugnant to the Constitution of the United States in that it violated the Establishment, Free Exercise, Free Speech, Free Press or Due Process Clauses?

On June 17, 1974 the United States Supreme Court issued an order which stated: "The judgment is vacated and the case is remanded to the United States District Court for the Middle District of Tennessee so it may enter a fresh judgment from which a timely appeal may be taken to the Court of Appeals."

In response to the Supreme Court's order, a brief for appellants was filed in the United States Court of Appeals for the Sixth Circuit on July 1, 1974. The brief maintained that abstention was appropriate only in the presence of special circumstances, none of which were present. Le Clercq stated: "The District Court's abstention order, in effect, negates Federal question jurisdiction contrary to the intent of Congress in the great acts vesting Federal question jurisdiction in the lower Federal courts. Abstention in the context of this case serves no useful purpose in promoting harmonious Federalism or comity." Oral argument on this appeal was presented by Le Clercq before the Sixth Circuit Court of Appeals in Cincinnati on October 4, 1974.

Author's Note: It is difficult to guess what effect the ruling by the United States Court of Appeals will have, but it should not be underestimated. Throughout this two year legal battle, NABT has maintained that efforts within states to legislate "equal-time" provision for religious viewpoints in biology are contrary to the United States Constitution. Such inclusion of creationist doctrine in biology textbooks and curricula amounts to establishment of religion which is clearly prohibited by the First Amendment. The Court's decision must therefore be very seriously considered by legislators *in all states* of the United States where "equal time" bills are contemplated.

Hendren v. *Campbell,* (Sup. Ct. No. 5, Marion County, Indiana)

Judge Michael T. Dugan II

Superior Court No. 5, County of Marion, State of Indiana

Late in 1975 the Indiana Commission on Textbook Adoption approved seven textbooks for adoption by local public school corporations. The list included the creationist biology text entitled: Biology, A Search for Order in Complexity. Parents of children enrolled in a public school using the creationist text filed suit, charging the text to be sectarian in nature and violative of constitutional prohibitions. Here is a copy of the memorandum opinion upholding the plaintiff's contentions.

STATE OF INDIANA, COUNTY OF MARION, MARION SUPERIOR COURT, NO. 5, CAUSE NO. S577-0139

* * * *

Jon Hendren, by next friend, Robert Hebdren, Robert Hendren in his own right, and E. Thomas Marsh, Plaintiffs,

-vs-

Glenden Campbell, Betty Crowe, Harold Negley, Sterling M. Halton, Janet Wickersham, William Lyon and Betty Lou Jerrell, Individually and in their official capacity as Members of the Indiana Textbook Commission, Defendants.

OPINION

I. STATEMENT OF FACTS

Before the court is a Verified Petition for Review (Amended Complaint) filed on March 23, 1977 on behalf of a ninth grade student, Jon Hendren, his father and another parent of a student in the West Clark Community School Corporation. The defendants are members of the Indiana Textbook Commission.

The Textbook Commission is responsible for the adoption of textbooks to be used in the public schools of Indiana. In the general area of biology the Commission adopted seven books, including the one at issue. From that list local school boards may then adopt texts to be used for a period of five years. Five school systems co-adopted this text with another text.(1) Two systems, West Clark Community Schools and South Ripley Community Schools adopted only *A Search for Order in Complexity.*

In all of these systems the text is in current use in the first year of the five year cycle.

On March 18, 1977 the Textbook Commission pursuant to an order of the Court convened a hearing on the use of this text. The Commission issued findings of fact on that date denying the request of the plaintiffs that the text be withdrawn. (Exhibit A)

II. NATURE OF THE CASE

This petition is brought under the Indiana Administrative Adjudication Act 10 1971, 4-22-1-2 et seq. in a judicial review of the action of the Textbook Commission. The general rule in Indiana has been that the reviewing court use the test of an agency's factual determination as whether there was substantial evidence in the administrative record to support the agency's finding.(2) More recently appellate courts have found that "Judicial attempts to define the meaning of substantial evidence have met with less than unqualified success."(3) Accordingly Courts may review the whole record, rather than merely evidence supporting the agency's findings. The Court is also asked to view the Commission's findings and the text in light of the Establishment Clause of the First and Fourteenth Amendments of the Constitution of the United States, Article 1, Section 4 of the Constitution of the State of Indiana, and I.C. 1971 20-10. 1-9-11 which provides:

> "The Commission on textbook
> adoptions shall not approve
> a textbook which contains
> anything of a partisan or
> sectarian character."

III. ISSUES

1. Was the finding of the Commission arbitrary, capricious, or an abuse of discretion or not otherwise in accordance with the law because it violates statuatory or constitutional prohibitions?
2. Were the findings of the Commission supported by substantial evidence at the administrative hearing?
3. Does the textbook violate statuatory and constitutional guarantees and prohibitions?

IV. REVIEW OF THE COMMISSION HEARINGS TESTIMONY AND EXHIBITS

At the hearing of the Commission, the Plaintiffs called ten witnesses, among them being biologists and theologians. The Attorney General called one witness, one of the authors of the text. All of the Plaintiff's witnesses complained that the book was "sectarian"in viewpoint. One witness, Dr. Jon R. Hendix, was also a member of the State Science Advisory Committee that wrote guidelines for science instruction for the State of Indiana. Dr. Hendix testified that the book was outside of state guidelines. The witness had recommended disapproval of the book.

The witness for the Attorney General, Dr. Larry G. Butler, was one of the authors of the book. Dr. Butler felt the book was "in accord" with his own Christian perspective.(5) A witness for the plaintiff, Donald L. Nead, observed that the main-line Protestant denominations, including Presbyterians, Methodist, United Church of Christ, Christian Church (Deciples of Christ), and certain elements of the Lutheran's and American Baptist Convention has not considered the theological basis of the book viable for many years.(6)

The Plaintiff also introduced nine exhibits including the book, *Teachers Guide,* and various letters and booklets from the publisher. In terms of the purpose of the textbook, a letter from Henry R. Morris, Ph.D., Director of the Institute for Creation Research relates:

> "The Institute for Creation
> Research is the research division of the Christian Heritage College, and all of the
> students in the College are
> given 90 class hours of instruction in creationism, so that
> they are all well equipped to
> be leaders in the creationist
> movement in the future."(7)

In another exhibit, Dr. Tim F. LaHaye, President of Christian Heritage College, discusses "the ministry of the Institute for Creation Research ...".it is a.."unique missionary organization...". "....it has a remarkable evangelistic and spiritual outreach."(8)

In a distribution brochure, including the text at issue, the publisher states:

> "We are seeking to inform the
> public about the latest findings
> regarding special creation, but

> we also desire to publish and distribute material which will educate the reader concerning scriptural evidence and religious thought, and which will help build up the body of Christ."(9)

Dr. Morris, in an article entitled "Creation in the Christian School" relates:

> "Although a considerable part of ICR's activity is aimed at the restoration of creationism in the nation's public schools and state universities, we realize this is difficult to accomplish and is a long-range goal rather than one quickly attainable."
>
> "In the public schools, for example, we urge that creationism be taught as an alternative to evolutionism not on a religious basis, but strictly on a scientific basis."
>
> "In a private Christian school, however, this neutral approach is neither necessary or desirable. Although students in such schools should be taught about evolution, the curriculum should stress throughout that creation is the only Biblical position and the only realistic scientific position as well."(10)

V. EXAMINATION OF THE TEXTBOOK AND *TEACHER'S GUIDE*

The textbook *A Search for Order in Complexity,* of some 595 pages and the *Teachers Guide,* of some 96 pages, were published in 1974 in revised editions by the Zondervan Publishing House. Distribution and promotion was thereafter done through the Institute for Creation Research.

The text itself includes some 23 chapters with corresponding teacher's guide with suggested answers to questions for students in the text. The text in its preface indicates:

> "There are essentially only two philosophic viewpoints of origins among modern biologists -- the doctrine of evolution and the doctrine of special creation. Proponents of the former postulate the gradual appearance of the various forms of life and of life itself by natural processes over vast ages of time. Exponents of the latter assume the essentially instantaneous origin of life and of the major kinds of living organisms by special creative acts utilized directly by the Creater Himself."

The text asserts that the two viewpoints "cannot really be harmonized... since they represent diametrically opposite viewpoints of origins."(12)

The index to the text seems, on its face, to support the assertion that the text attempts to present both viewpoints for consideration by the thoughtful student. Under "Creation Theory" are found 47 reference pages in the index while 88 reference pages are listed for "Evolution Theory."(13)

The "Glossary of Terms" also seems to support a balance view by defining the viewpoints as follows:

> "*Creation,* the sum total of acts by the Creator or Supreme Being who brought into existence the universe, the earth, and all life, including mankind that is therein."
>
> "*Evolution,* the explanatory belief system that all life, including mankind, came from an inorganic beginning from one celled forms through multicellular organizations of two-cell layered and three-celled layered forms of animals and moss and ferns and flowering plants."(15)

In fact, the text consistantly presents creationism in a positive light and evolution in a negative posture. The preface summarizes the program of the text followed in the text itself.

Discussing the evolution and creation "models" the preface presents a definition of each followed by tests and predictions necessary to support each theory. As to evolution, the text asserts "basic predictions" as being:

> "...processes which tend to produce functional similarities...

with no 'gaps' of any consequence between adjacent kind."

".....processes which tend to produce new entities in an even higher state of order and integration;"

"...that variety and complexity of the world and all its inhabitants tend to increase as time increases."(16)

Discussing the evolution predictions in the text, the authors state at page xix:

"the inference of a continuous array of such similarities,... is not supported by the data."

"Secondly, study of various processes does bear out the evolutionary inference..."

"Once again, however, this evidence is not very compelling... (and) "seem always to fall into one of two categories." (These categories)..."may be used better to support the principles of conservation and decay rather than origination and integration, as proponents of the evolution model would suggest."

"the inference that the complexity of life should have increased with the passage of geologic time...is seriously weakened by the necessity of circular reasoning in its development."(17)

The preface disputes "index fossils" starting at page xx:

"...the fossil record does not necessarily reflect slow, uniformitarian evolutionary change over vast ages, but rather contains a graphic record of violence and death on a worldwide scale."

Summarizing, the preface concludes:

"The evolution mode contains numerous deficiencies and discrepancies. One may adhere to it as an act of faith, but it is fallacious and misleading to label it 'science'."(18)

As to the creation model, the preface relates at page xx and xxi:

"That there was a period of special creation in the past, during which the world was brought into existence out of nothing but the power of the Creater..."

"The features of the creation model are confirmed by most or all of the actual observed phenomena of nature, thus demonstrating the validity of the creation model as being scientifically sound..."

"Similarly, the second law (increasing entrophy) is essentially a confirmation of the universal law of decay and death postulated in accordance with the biblical version of the creation model."

"In fact, there seems to be no way of accounting for most of the great fossil beds of the world...except in terms of very rapid burial and lithification, such as might be possible in accordance with the biblical deluge, and accompanying volcanic and lectonic activity and inferred subsequent glaciological phenomena."

Summarizing the creation model, the preface concludes at page xxii:

"On this basis, the creation model is a framework of interpretation and correlation which is at least as satisfactory as the evolution model."

"However, (the various principals and laws) all may be correlated far more easily with the creation model than with the evolution model."

"Furthermore, the data and principles of physics, chemistry and the other physical sciences are much more easily understood within the framework of the creation model than in that of the evolution model."

Finally at pages xxii and xxiii of the preface, the editor states:

"Evidences usually presented in support of evolution as a *model* of origins are accurately presented and considered. At the

> same time, it is explicit throughout the text that the most reasonable explanation for the actual facts of biology as they are know scientifically is that of biblical creationism."
>
> "We hope this approach will be attractive first of all to the many private schools directed by those seeking to maintain an educational philosophy and methodology consistant with traditional Christian perspectives. We trust it will also be of interest and use in public school systems by teachers desiring to develop a genuine scientific attitude in their students rather than an artificially induced evolutionary world view."

Most of the chapters in the text itself deal with non-controversial elements of biological science such as insects, chemical principles, algae, one-celled organisms, and so on. The book is replete, however, with references to biblical topics, the..."wonderful findings of God's creation"...and..."divine creation" as being the only correct viewpoint to be considered. Throughout the text, while both viewpoints are mentioned, biblical creation is consistantly presented as the *only* correct "scientific" view. Two entire chapters, in fact, are devoted to lengthy discussions of the fallacies and weaknesses of the evolution viewpoint. Chapter 21 "Weakness of Geologic Evidence" goes into great detail disputing evolutionary theories as to fossils and geologic evidence. It explains fossils "...by the fact that most fossil material was laid down by the flood in Noah's time."(20) Chapter 24, "Problems for Evolutionists" devotes some eight pages to arguments refuting evolution theory. There are no chapters or passages in the text which deal critically with biblical creationism.

Also persuasive as to the avowed purpose of the book is the *Teacher's Guide*. This publication, designed for teacher in using the text, summarizes the text, offers suggestions for use and enrichment and provides answers to questions found at the end of textbook chapters. These questions are designed to test the student as to his understanding and study of each chapter.

A review of some of the questions and corresponding "correct" answers is instructive.

> Question 10, page 163, text:
> "To what extent was Alexander Flemming's discovery based on chance, and to what extent on training?"
>
> Answer, page 39, *Teachers Guide:*
> "It was 'chance' (under the direction of God's providence) which allowed the penicillian spores to get into the culture dishes of bacteria..."
>
> Question 8, page 77, text:
> "Why does an old human skeleton of low type sometimes receive more attention than an old human skeleton of the same type as living men?"
>
> Answer, page 77, *Teachers Guide:*
> "Some persons believe that evolution has been amply demonstrated to be true. When a skeleton of low type is found, they jump to the conclusion that it is ancestral to modern man. Such persons forget that they are using their *assumption* of evolution as *proof* of evolution."
>
> Question 7, page 459, text:
> "How does the Doctrine of evolution by natural selection explain the development of altruism, or doesn't it?"
>
> Answer, page 79, *Teacher's Guide:*
> "If the doctrine of evolution were true, it would favor heartless ruffians such as bandits and weeds. An altrusive person would be less 'fit' to survive. On the other hand, where a majority of a group of people recognize God, they appreciate and favor the alturistic person."
>
> Question 7, page 471, text:
> "Creationists believe there are limits to natural change. Are they afraid to extrapolate, or are there reasons for such a

belief?"
Answer, page 81, *Teacher's Guide:*
"An evolutionist might say, If you recognize small changes, multiply them by the number of years the earth has existed and you will have learned, however, that there are limits beyond which small changes no longer accumulate."
Question 8, page 471, text:
"What do hydra, the opossom and the jack pine teach about development of complexity?"
Answer, page 81, *Teacher's Guide:*
"A complex animal or plant does not, *because of its complexity,* have an advantage in the struggle for existence. Complexity must have been conferred by the Creator rather than by natural conditions such as we observe today."

VI. APPLICATION OF STATUTORY AND CONSTITUTIONAL STANDARDS

Numerous cases in the history of the United States have dealt with issues of the 1st Amendment to the Constitution.(21) The United States Supreme Court has frequently determined that the authors of the Constitution did not merely prohibit the establishment of a state church or a state religion. This nation's founders regarded such a matter as one to be carefully and seriously avoided. They stated through the Constitution that there should be "no law respecting an establishment of religion." The Supreme Court has interpreted this to mean that:

> "A given law might not *establish* a state religion but nevertheless be one respecting that and in the sense of being a step that could lead to such establishment and hence offend the First Amendment."(22)

The Court has not required *total* separation between church and state. Many regulations and laws involve the co-existence of church and state such as tax exemption of property for religious worship. Judicial caveats against entanglement must recognize that the line of separation, far from being a wall, is a blurred, indistinct and variable barrier depending on all the circumstances of a particular relationship.(23) In fact a sense of neutrality has been a goal of the courts as it relates to the state and religion. As Mr. Justice Douglas pointed out:

> "We sponsor an attitude on the part of government that shows no partiality to any one group and that lets each flourish according to the zeal of its adherents and the appeal of its dogma."(23)

For example in *Walz* v. *Tax Commission* the Supreme Court found that:

> "The legislative purpose of a property tax exemption is neither the advancement nor the inhibition of religion; it is neither sponsorship nor hostility."(25)

In *Walz* it was pointed out that New York City had not given preference to any particular church or religious sect. Instead a tax exemption was granted to houses of religious worship within a broad class of property. The Court had no problem with the fact that the state...

> "has an affirmative policy that considers these groups as beneficial and stabilizes influences in community life and finds this classification useful, desirable and in the public desirable."(26)

As Mr. Justice Harlan pointed out in *Walz:*

> "Two requirements frequently articulated and applied in our cases for achieving this goal are 'neutrality' and 'voluntarism.' These related and mutually reinforcing concepts are short-form for saying that the Government must neither legislate to accord benefits that favor religion or nonreligion, nor sponsor a particular sect, nor try to encourage participation in or abregation of religion."(27)

As a result of the balancing of state and religion throughout this nation's history, courts have also recognized the constitutional rights of individuals to substitute private and parochial schools to exercise dissent and independent views.(28)

In fact it is well recognized that parochial schools in our society perform both religious and secular functions. Their right to foster particular religious views is unquestioned. Their obligation to provide secular education regulated by the state is also certain.(29) States may even provide certain benefits to parochial schools such as transportation, books, and allowing students to be released from public school classes to attend religious instruction.(30) These types of benefits have not been held to subvert the prohibition of the First Amendment.

Three tests have been offered by the Supreme Court to measure whether the action of the state has stepped beyond the prohibition of the First Amendment. These tests are designed to prevent "sponsorship," financial support, and active involvement of the sovereign in religious activity."(31) These tests are:

1. The statute must have a secular legislative purpose.
2. The principal or primary effect must be one that neither advances or inhibits religion.
3. The statute must not foster an excessive governmental entanglement with religion.(32)

Three cases are particular instructive. In *Epperson* v. *Arkansas*(33), a public school biology teacher brought an action challenging an Arkansas statute which prohibited teachers from teaching Darwinian theory. Mr. Justice Fortas found that the statute was contrary to the First and Fourteenth Amendments pointing out that as early as 1872 the Supreme Court has said: "The law knows no heresy, and is committed to the support of no dogma, the establishment of no sect."(34) He continued: "There is and can be no doubt that the First Amendment does not permit the State to require that teaching and learning must be tailored to the principles or prohibitions of any religious sect or dogma."(35)

Finding that the clear purpose of the statute was the advancement of fundamentalist sectarian conviction the Court found such purpose untenable under our Constitution. The Supreme Court was not pursuaded that the Arkansas statute was carefully worded to be "less explicit" than its predecessor the Tennessee "monkey law."(36) Pointing out that the Scopes trial may have induced the state to temper its statute, nevertheless,

> "...there is no doubt that the motivation for the law was the same: to suppress the teaching of a theory which it was thought 'denied' the devine creation of man."(37)

Mr. Justice Black, in a concurring opinion, however, (discussed) the difficulty of these cases. He expressed the doubts addressed by the Attorney General in this case as to whether neutrality is served by striking down such statutes. He reminded the Court:

> "The Darwinian theory is said to challenge the Bible's story of creation: so too have some of those who believe in the Bible, along with many other's, challenged the Darwinian theory. Since there is no indication that the literal Biblical Doctrine of the origin of man is included in the curriculum of Arkansas schools, does not the removal of the subject of evolution leave the State in a neutral position toward these supposedly competing religious and anti-religious Doctrines."(38)
>
> "Certainly the Darwinian theory precisely like the Genesis story of the creation of man is not above challenge."(39)

In *Metzer* v. *Board of Public Instruction*(40) decided in March 1977, Florida Courts reviewed a school board policy encouraging daily Bible reading to public school students and the distribution of Gideon Bibles. The Court found that this policy violated the prohibitions of the First Amendment. The School Board argued that its policy was justified in that it directed school officials to labor faithfully and earnestly for the advancement of the pupils in their studies, deportment and morals; and embrace every opportunity to inculcate, by precept and example, the principles of truth, honesty and patriotism and the practice of every Christian virtue."(41)

Citing a number of cases the Court demonstrated that the distribution of Gideon Bibles "...approximates an annual promotion and endorsement of the religious sects or groups which follow its teaching and precepts."(42)

The school board's policy was found to constitute an unconstitutional preference to one religion over another. The court found that the purpose of a Florida "Christian Virtue" statute was to advance a particular religion. They rejected arguments that the word "Christian" was a mere adjective with little implication as to its application.

> "The phrase "Christian Virtue" suggests a very particular type of virtue that is tied particularly to one religion, and a type of virtue that is or may be at odds with minority religions concept of virtue. If the statute had required inculcation of "Jewish virtue' or "Moslem virtue' we have no doubt that the unconstitutionability of the statute would be conceeded by all."(43)

Finally, the 1975 case of *Daniel* v. *Waters*(44) should be viewed with this action. In *Daniel* a Tennessee statute was examined which required that any textbook expressing an opinion about the origin of man would be prohibited from use unless it specifically stated that the opinion was a theory. The statute also required that the biblical account of creation as set forth in Genesis be printed with commensurate attention and equal emphasis. Lastly, the statute required that biblical creation be printed without a disclaimer that is was a theory not represented by scientific fact. The Court of Appeals found that this statute violated the First Amendment. They found that "the result of this legislation is a clearly defined preferential position for the Biblical version of creation as opposed to any account of the development of man based on scientific research and reasoning."(45) The court argued that teaching and learning cannot be "tailored" to the principles or prohibitions of any religious dogma.

Clearly, it is not the function of the courts to determine the validity or fallacy of any religious doctrine. In fact the judiciary has long had an abborence to wandering into the thicket of conflicting dogmas and creeds. Personal considerations of the court have no place in the determination of cases of this type.

The constitution of the State of Indiana has expressed its confirmation and interpretation of the First Amendment by providing that "no preference shall be given, by law, to any creed, religious society, or mode of worship..." In this case we do not have that situation of an obvious statuatory attempt to impose religious doctrines on the citizens of Indiana. On the contrary, we face a textbook which, on its face, appears to present a balanced view of evolution and Biblical Creation. The record and the text itself do not support this assertion of fairness. Since the Scopes controversy over fifty years ago, the courts of this country have faced repeated attempts by groups of every conceivable persuasion to impose particular standards, whether religious or eithical, on the populace as a whole. We may note that with each new decision of the courts religious proponents have attempted to modify or tailor their approach to active lobbying in state legislatures and agencies. Softening positions and amending language, these groups have, time and again, forced the courts to reassert and redefine the prohibitions of the First Amendment. Despite new and continued attempts by such groups, however, the courts are bound to determine, if possible, the *purpose* of the approach.

Clearly, the purpose of *A Search for Order in Complexity* is the promotion and inclusion of fundamentalist Christine doctrine in the public schools. The publishers, themselves, admit that this text is designed to find its way into the public schools to *stress* Biblical Creationism. The court takes no position as to the validity of either evolution or Biblical Creationism. That is not the issue. The question is whether a text obviously designed to present *only* the view of Biblical Creationism in a favorable light is constitutionally acceptable in the public schools of Indiana. Two hundred years of constitutional government demand that the answer be *no*. The asserted object of the text to present a balanced or neutral argument is a sham that breaches that "wall of separation" between church and state voiced by Thomas Jefferson. Any doubts of the text's fairness is dispelled by the demand for "correct" Christian answers demanded by the *Teacher's Guide*. The prospect of biology teachers and students alike, forced to answer and respond to continued demand for "correct" fundamentalist Christian doctrines, has no place in the public schools. The attempt to present Biblical Creationism as the only accepted scientific theory, while novel, does not rehabilitate the constitutional violation.

After consideration of the text and the evidence at the agency hearing, the action of the Indiana State Textbook Commission is untenable. Government cannot be insensitive to the Constitution and statutes of the nation and state. Their approval both advanced particular religious preferences and entangled the state with religion. The decision of the commission is without merit and violative of both statuatory and constitutional provision.

VII. FINDINGS OF THE COURT

1. The findings of the Indiana Textbook Commission were arbitrary, capricious and an abuse of discretion.
2. The findings were inconsistent with the evidence at the administrative hearing.
3. The findings of the Commission were in violation with I.C. 1971 20-10.1-9-11; Article 1, Section 4 of the Constitution of the State of Indiana, and the First Amendment of the Constitution of the United States.
4. The textbook *A Search for Order in Complexity*, as used in the public schools, violates I.C. 1971 20-10.1-9-11; Article 1, Section 4 of the Constitution of the State of Indiana, and the First Amendment of the Constitution of the United States.

IT IS THEREFORE ORDERED AND ADJUDGED that the findings of the Indiana State Textbook Commission are reversed, and the Commission is ordered to make findings not inconsistent with this decision after re-hearing.

So ordered.

Michael T. Dugan II (signed)
Judge
Marion Superior Court, No. 5

Dated: April 14, 1977

* * * * * * *

FOOTNOTES

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(1) Baughgo Community Schools, Union Township Schools, Warsaw Community Schools, Morgan School District (Martinsville), East Washington School Corporation.

(2) *Boone Co. Rural Elec. Membership Corp.* v. *Public Serv. Comm'n*, 239 Ind 525, 159 N.E. 2d 121 (1959).

(3) *City of Evansville* v. *Southern Indiana Gas & Electric Co.*, 339 N.E. 2d 562 (Ind. Ct. App. 1975).

(4) *Hearing before the Indiana Textbook Commission*, March 16, 1977, p. 74.

(5) *ID*, p. 131

(6) *ID*, p. 36

(7) *ID*, Exhibit #4

(8) *ID*, Exhibit #7

(9) *ID*, Exhibit #9

(10) *ID*, Exhibit #8

(11) *A Search for Order in Complexity*, pp. xvii

(12) *ID*, pp. xviii

(13) *ID*, pp. 576, 577, 579

(14) *ID*, p. 555

(15) *ID*, p. 556

(16) *ID*, pp. xviii, xix

(17) *ID*, p. xix

(18) *ID*, p. xx

(19) *ID*, pp. 3, 8

(20) *ID*, p. 415

(21) *Abington School Dist.* v. *Schempp*, 374 US 203, 10 Led 2d 844, 83 SCt 1560 (1963)
Engle v. *Vitale*, 370 US 421, 8 LEd 2d 601, 82 SCt 1261 (1962)
McGowan v. *Maryland*, 366 US 420 6 LEd 2d 393, 81 SCt 1101 (1961)
Everson v. *Board of Education*, 330 US 1, 91 LEd 711, 67 SCt 504 (1947)

(22) *Lemon* v. *Kurtzman*, 403 US 602, 29 LEd 2d 745, 91 SCt 2105 (1971), p. 755

(23) *ID*, p. 757

(24) *Zorach* v. *Clauson*, 343 US 306, 96 LEd 954, 72 SCt 679 (1952) p. 31

(25) *Walz* v. *Tax Commission*, 397 US 664, 25 LEd 2d 697, 90 SCt 1409 (1970) p. 703

(26) *ID*, p. 704

(27) *ID*, p. 716

(28) *Pierce* v. *Society of Sizlers*, 268 US 510, 69 LEd 1070, 45 SCt 571

(29) *Board of Education* v. *Allen*, 392 US 236, 20 LEd 2d 1060, 88 SCt 1923 (1968)

(30) *Averson*, supra.
Allen, supra.
Zorach, supra.

(31) *Walz*, supra.

(32) *Lennon*, supra, p. 755

(33) *Epperson* v. *Arkansas*, 393 US 97, 21 LEd 2d 228, 89 SCt 266 (1968)

(34) *ID*, p. 234, LEd 2d

(35) *ID*, p. 235

(36) *ID*, p. 237

(37) *ID*.

(38) *ID*, p. 240

(39) *ID*.

(40) *Meltzer* v. *Board of Public Instruction of Orange City, Fla.*, 45 L.W. 2434, (1977)

(41) *ID*.

(42) *Brown* v. *Orange County Board of Public Instruction*, 128 So. 2d 181 (Fla. App. 1960)
Tudor v. *Board of Education*, 100 A. 2d 857 (N.J. 1953)
Godwin v. *Cross County School District*, 394 F. Supp 417 (Ed Ark.)

(43) *Meltzer*, p. 2435

(44) *Daniel* v. *Waters*, 515 F. 2d 485 (1975)

(45) *ID*, p. 489

* * * * * * * *

EXHIBIT "A"

BEFORE THE COMMISSION ON TEXTBOOK ADOPTION

Jon Hendren, by next friend, Robert Hendren - Robert Hendren, in his own right - E. Thomas Marsh, Complainants

vs.

The Commission on Textbook Adoption, Respondent

DETERMINATION OF COMMISSION ON TEXTBOOK ADOPTION

FINDINGS OF FACT

1. Complainants have filed a complaint with the Commission concerning the adoption of the textbook entitled *Biology: A Search for Order in Complexity.*
2. Complainants seek to have the Commission withdraw its approval of the textbook entitled *Biology: A Search for Order in Complexity* on the grounds that the textbook is violative of IC 1971, 20-10.1-9-11 and the First Amendment to the Constitution of the United States in that it is alleged that the textbook is of a sectarian character.
3. On March 16, 1977 the Commission pursuant to a request of the complainants held an administrative hearing pursuant to the provisions of the Administrative Adjudication Act, IC 1971, 4-22-1-1 et seq. At which time

evidence was presented and arguments of counsel heard.

4. The biology textbook in question was adopted by the Commission on December 12, 1975 as one of seven textbooks available for adoption by local school corporations. Such adoption by the Commission made with full compliance with the procedures as set out in IC 1971, 20-10.1-9-1.

5. The complainants object to certain provisions of the textbook and allege them to be of a sectarian nature and character.

6. The textbook sets out two theories on the origin of man and the species, i.e., the theory of evolution and the theory of creation.

7. The textbook states that neither is subject to scientific verification.

CONCLUSION OF LAW

1. The textbook entitled *Biology: A Search for Order in Complexity* is not violative of I.C. 1971, 20-10.1-9-11 nor violative of constitutional prohibitions.

DETERMINATION

Complainants request to have the Commission withdraw is approval of the textbook entitled *Biology: A Search for Order in Complexity* is hereby denied.

Dated this 18th day of March, 1977.

Commission on Textbook Adoption

By: Harold H. Negley (signed)
Chairman

Copies to: William G. Mundy
Deputy Attorney General
Indianapolis, Indiana

Irving L. Fink
Attorney for Complainants
602 Board of Trade Bldg.
Indianapolis, Indiana

Proposed Laws Against the Teaching of Evolution

S. J. Holmes

Reprinted with permission from the *Bulletin of the American Association of University Professors,* December 1927, (Vol. 13, No. 8).

This report was prepared and published fifty years ago! Much of it could apply, after geographic and date changes, to the situation experienced in this country during the past five years. The original report was prepared by a committee named by the American Association of University Professors chaired by Professor S. J. Holmes.

The legislative year just passed has been remarkable for an unusually large number of proposed laws to restrict the freedom of teachers of science. In all these proposed laws the theory of evolution has been the special object of attack. The movement to secure legislative prohibition of the teaching of evolution began in Oklahoma in 1923, when a clause was introduced into the free textbook law which forbade the use of any book in the public schools teaching "the Darwin theory of creation versus the Bible theory of creation." This law was repealed in 1925. In 1923 the legislature of Florida passed a resolution declaring it to be "improper and subversive to the best interests of the people of this state for any professor, teacher, or instructor in the public schools and colleges supported in whole or in part by public taxation, to teach, as true, Darwinism or any other hypothesis that links man in blood relationship to any other form of life." As this act was merely a resolution it could safely be disregarded and it had little effect on the actual conduct of teaching. In Texas the State Textbook Commission adopted textbooks in which discussions of evolutionary theory had been deleted by the publishers. There was no attempt to interfere with instruction in colleges and universities and the activities of the Board probably had little influence upon instruction in the secondary schools.

The most vigorous action against the teaching of evolution was taken by Tennessee in 1925, by the passage of the law which led to the notorious Scopes trial. This law made it unlawful to teach in state supported schools "any theory that denies the story of the divine creation of man as taught in the Bible, and to teach instead that man was descended from a lower form of animals. A fine of from $100 to $500 was imposed as a penalty for the violation of this act. The spectacular trial and conviction of Scopes under this law attracted world-wide attention and comment and the episode is now familiar to all readers.

Nothwithstanding the unenviable

publicity incurred by the Scopes trial, the example of Tennessee was followed in 1926 by Mississippi in which a very similar law was passed and signed by the Governor. A teacher who violates this law may be fined not more than $500 and "shall vacate the position thus held in any educational institution of the character above mentioned or any commission of which he may then be a member."

That a person may be fined and even sent to jail for teaching a theory which is accepted by practically all qualified biologists comes as a rude shock to those who look upon this country of ours as one which cherishes freedom of thought and speech. It is safe to assume that the great majority of the legislators who voted for such statutes were quite innocent of even a rudimentary knowledge of modern biology. They probably did not know that evolution is all but universally accepted by men of science the world over and that in the world of scholars it has long since passed its period of trial. It was indeed a surprise to many that there could be legislators who could vote for such laws and governors who could sign them. But the worst feature of the situation is not so much the intellectual backwardness revealed by the passage of these statutes as the spirit of religious intolerance and disregard of intellectual liberty which prompted their enactment.

It must be said to the credit of many opponents of the theory of evolution that they refused to countenance the attempt to suppress the views of their adversaries by an appeal to the law. They hold on principle that people should not be persecuted for advocating or defending certain doctrines; that teachers should be free to express their views on controverted questions; and that it is much more important to keep the public schools free from sectarian domination than it is to have them inculcate the particular views in which one happens to believe. As the Reverend C. W. Wilmer, Dean of the Theological School of the University of the South, has remarked, "It is for scientists and not civil legislatures to say what is science, just as it is for mathematicians and not politicians to say what is mathematical truth. The church must render unto Caesar the things that are Caesar's and also unto science those things that belong to science; and must under no circumstances undertake to force the state to do its bidding in order to put over its religious views or to interfere with the states, giving to our boys and girls scientific teaching confined within the limits of the scientific realm." It was largely due to the influence of liberal-minded and tolerant adherents of orthodox denominations that we were saved from further encroachments upon freedom of teaching during the past year.

Determined attempts to suppress the teaching of evolution were made during the present year in several states both north and south. In Arkansas an anti-evolution bill strongly supported by the Baptists was carried in the House by a vote of 50 to 47. When it came to the Senate, however, the bill was voted down by a large majority, 25 to 6. A similar bill was defeated in Oklahoma by a vote of 46 to 30. A vigorous fight was anticipated in Missouri, but the anti-evolution resolution was defeated by a vote of 82 to 62. An anti-evolution resolution was voted down in the West Virginia legislature, 57 to 36, and further attempts at adverse legislation apparently were not made. Efforts to secure an anti-evolution law in Delaware met with little encouragement. In Georgia the anti-evolution movement was taken up by the "Supreme Kingdom" one of whose avowed objects was to stamp out the theory of evolution. The cause of the anti-evolutionists probably gained little through the support of this organization. An anti-evolution bill was introduced, but according to one of my correspondents "was laughed to death in the House Committee as a fortunate outcome of the spectacle which Tennessee had made of itself." A similar bill introduced in Alabama was killed in Committee.

The anti-evolutionists were

decisively defeated in North Carolina, but there is an influencial opposition to evolution in that state. The State Board of Education in 1924 rejected several textbooks on biology on the ground that they taught the pernicious doctrine of descent. In South Carolina an anti-evolution measure was defeated also.

During its last session the legislature of Florida considered a law restricting the teaching of evolution but it was so amended in the House as to lose all its force, and even in its amended form failed to pass the Senate, although passed by the House 64-24. The bill was scored by most of the newspapers, and evoked the protest of President Holt and the faculty of Rollins College, but it was supported by a large and active lobby. A resolution providing for a censorship of textbooks was passed and signed by the Governor, but this contained no reference to the theory of evolution.

The most spectacular demonstration over anti-evolution legislation was made in Minnesota. Two copies of the Minnesota Daily, a paper published by the students of the University of Minnesota, was largely devoted to an attack upon an anti-evolution bill introduced into the legislature through the influence of the Reverend Mr. Riley. These issues of the paper contained letters of protest against the bill by all of the deans of the university and several members of the faculty; an open letter to the legislature by the organized student body; a copy of the protests against the bill adopted by the faculty; statements opposing the bill issued by several prominent ministers; and a ringing editorial in defense of the principle of freedom in teaching. The students held a great mass meeting attended by almost the entire student body of over 5,000 students led by the university band. As stated by the Daily, "The mass meeting was described by the faculty members and student guiders as the largest and most spontaneously enthusiastic in university annals. The 5,000 students stood for twenty minutes to listen to the speakers, cheered every attack upon the bill, and passed a resolution of condemnation with a resounding Aye from 5,000 throats." A monster petition condemning the bill was circulated and signed by almost every student of the university. The University of Minnesota put itself on record in no uncertain terms as opposed in principle to legislative interference with the work of the scholar.

The indignant protest with which the Riley bill was very properly met was not confined to the State University. Other colleges in Minnesota also took vigorous action against the bill and sent in their protests. If the members of the legislature had any doubts as to how the scholastic world stood in relation to the anti-evolution crusade the doubts would have been speedily dispelled. At any rate the bill was badly defeated. In the Senate it secured only seven votes and when it reached the House a motion for indefinite postponement was passed unanimously.

An anti-evolution bill was introduced into the legislature of California, but it was unanimously voted down by the Committee on Education after its proponents and opponents were given a hearing.

In 1927, anti-evolution bills have been defeated in all the states in which they were introduced. Whether the mania for persecuting the theory of evolution will now subside it would be unsafe to predict. Legislatures in general would prefer not to meddle with the teaching of science. But there will be plenty of fanatics to keep up the fight and there will be a good deal of money available for carrying on their campaign, so they may continue to be an annoyance for some time to come.

The anti-evolution movement has no support from real scholars; it has no leadership among men of high reputation for intellectual achievement. Scientists of note, to say nothing of scholars in other fields, are opposed to it practically to a man. It probably could not find a single supporter in such bodies as the American Society of Zoologists, the American Society of Botanists, the Society of Naturalists, or any other association of equally competent persons. Nevertheless the movement is a strong one. Where the educational level of the community is the lowest, the enemies of intellectual freedom command the greatest following. The strength of the movement is a revelation of the backwardness and intolerance of large elements of our population. The real driving force back of the anti-evolution crusade is, of course, religious intolerance. A large and determined body of individuals have deliberately set out to have their own religious dogmas protected by law. Anything which disagrees with their peculiar brand of theology simply must not be taught, and they attempt to protect their beliefs by putting every teacher in an intellectual straight jacket. Their real object is the practical establishment of a state church founded on a reactionary form of fundamentalist Christianity which is unacceptable alike to men of science and to liberal-minded members of orthodox denominations.

One phase of this issue is often misunderstood. Many persons suppose that evolutionists desire to displace a theological dogma by a scientific dogma, the teaching being in either case by sheer authority. Since sectarian instruction is debarred from the schools it is claimed that in fairness the state should not support instruction which is opposed to sectarian teachings, especially when these represent the views of the majority of the taxpayers. This plea, which has been strongly urged by Mr. Bryan, may seem plausible to many who are somewhat confused as to the real merits of the question involved. But the argument is really a specious one, and is based on a radical misconception of the aim and true spirit of instruction in science. The theory of evolution, like any other scientific theory, is simply an attempt to account for certain facts. If there are religious dogmas with which the theory of evolution is not in accord, this fact affords no excuse for any attempt to keep students ignorant of it and of the reasons why scientists accept it. The policy of protecting particular doctrines by legislative prohibition of instruction on certain topics is vicious in principle and should never be allowed to gain headway. The right of the teacher to express his views on all theoretical questions relating to his field of instruction should always be maintained against all efforts to restrict his freedom.

Let us not be deceived as to the fundamental issue before us. It really has nothing to do with whether the theory of evolution is true or false. In any case, it would be ridiculous to try to settle such a matter by legislative enactment. The real question is whether or not we wish to make an intellectual slave of every teacher in a state supported institution and to force him to square his teaching with the dogmas of any group which succeeds in getting legislative protection for its doctrines.

The literature of the anti-evolution crusaders reveals only too clearly the aims and animus of the leaders of the movement. As Mr. Morris Houghton has remarked, "The Fundamentalists have been marching steadily toward their goal, which is a national legislative straight jacket for thought and education. Of all the challenges to leadership on the part of the men who head our institutions of learning this creeping medievalism, it seems to us, is easily the greatest since the Civil War."

With the success of this movement the right of the teacher to present the truth as he sees it would be taken away. What is to be taught as science would be determined not by the consensus of the best scientific opinion, but by the votes of shop girls and farm hands ignorant alike of science and of the foundation principles of our civil society. A policy which is better calculated to drive self-respecting persons out of the teaching profession it would be difficult to conceive. All teachers, from those in universities to those in elementary schools, are vitally interested in opposing the humiliating restrictions which the forces of religious intolerance are attempting to impose upon them. That these forces have been strong enough to secure legislative enactments forbidding instruction contrary to their dogmas and that it is possible for them to secure as many votes as they have in several state legislatures where their bills failed to pass, is a matter which cannot be looked upon with pride, nor without a measure of anxiety.

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Resolutions of Learned Societies in the Textbook Controversy

Reprinted with permission from *The American Biology Teacher*, January 1973, (Vol. 35, No. 1).

In the early Seventies, during a process of state textbook adoption, the California State Board of Education was faced with implementing a guideline calling for inclusion of creationist doctrine in science textbooks. This provided stimulus for several societies to voice objections by issuing the resolutions printed here. An attempt to resolve the California Science Framework problem occurred in March of 1974 when the State Board revised the guideline by recognizing that "philosophic and religious considerations pertaining to the origin ...of life are not within the realm of science."

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Whereas some State Boards of Education and State Legislatures have required or are considering requiring inclusion of the theory of creation as an alternative to evolutionary theory in discussions of the origins of life, and

Whereas the requirement that the theory of creation be included in textbooks as an alternative to evolutionary theory represents a constraint upon the freedom of the science teacher in the classroom, and

Whereas inclusion of the theory of creation also represents dictation by a lay body of what shall be considered within the corpus of a science,

Therefore, the American Association for the Advancement of Science strongly urges that reference to the theory of creation, which is neither scientifically grounded nor capable of performing the roles required of scientific theories, not be required in textbooks and other classroom materials intended for use in science curricula.

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NATIONAL ACADEMY OF SCIENCES

Whereas we understand that the California State Board of Education is considering a requirement that textbooks for use in the public schools give parallel treatment to the theory of evolution and to belief in special creation; and

Whereas the essential procedural foundations of science exclude appeal to supernatural causes as a concept not susceptible to validation by objective criteria; and

Whereas religion and science are, therefore, separate and mutually exclusive realms of human thought whose presentation in the same context leads to misunderstanding of both scientific theory and religious belief; and

Whereas, further, the proposed

action would almost certainly impair the proper segregation of the teaching and understanding of science and religion nationwide, therefore

We, the members of the National Academy of Sciences, assembled at the autumn 1972 meeting, urge that textbooks of the sciences, utilized in the public schools of the nation, be limited to the exposition of scientific matter.

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AAAS COMMISSION ON SCIENCE EDUCATION

The Commission on Science Education of the American Association for the Advancement of Science is vigorously opposed to attempts by some boards of education, and other groups, to require that religious accounts of creation be taught in science classes.

During the past century and a half, the earth's crust and the fossils preserved in it have been intensively studied by geologists and paleontologists. Biologists have intensively studied the origin, structure, physiology, and genetics of living organisms. The conclusion of these studies is that the living species of animals and plants have evolved from different species that lived in the past. The scientists involved in these studies have built up the body of knowledge known as the biological theory of the origin and evolution of life. There is no currently acceptable alternative scientific theory to explain the phenomena.

The various accounts of creation that are part of the religious heritage of many people are not scientific statements or theories. They are statements that one may choose to believe, but if he does, this is a matter of faith, because such statements are not subject to study or verification by the procedures of science. A scientific statement must be capable of test by observation and experiment. It is acceptable only if, after repeated testing, it is found to account satisfactorily for the phenomena to which it is applied.

Thus the statements about creation that are part of many religions have no place in the domain of science and should not be regarded as reasonable alternatives to scientific explanations for the origin and evolution of life.

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ACADEMIC SENATE OF THE UNIVERSITY OF CALIFORNIA

It is our understanding that within the next few months the California State Board of Education will be approving many science textbooks for use in California public schools, grades K through 8. The text of the *Science Framework for California Schools,* prepared in 1969, suggests that one criterion for the board's approval of a text may be the extent to which, in the discussion of the origins of life, a "special theory of creation" is treated as a scientific theory in a manner parallel to an account of evolution. We believe that a description of special creation as a scientific theory is a gross misunderstanding of the nature of scientific inquiry.

To provide the basis of a scientific theory, an hypothesis must make testable predictions. Our ideas of biological evolution are continually being tested in the process of an enormous amount of investigation by thousands of professional biological scientists throughout the world. As in all sciences, there are many facets of the evolution picture that are not yet thoroughly understood, and researchers at the frontier of knowledge, often in disagreement with each other concerning details, continually revise their thinking. Thus, evolutionary theory itself has evolved considerably since the time of Darwin. But virtually all biological scientists are agreed on the broad features of the theory of evolution of life forms, the evidence for which is completely overwhelming.

The issue is not whether the concept of a relatively sudden special creation is true or valid, but rather that its origin lies in philosophical thought and religious beliefs, not in scientific investigation. Partly because of the wide diversity of religious opinions regarding creation, and especially because of our traditional adherence to the First Amendment of the United States Constitution requires the separation of religious instruction from state supported schools, we believe that the teaching of special creation should be avoided entirely in California public schools; certainly, it should not be presented in textbooks as a scientific theory.

We join the National Academy of Sciences, the American Association for the Advancement of Science, and other learned societies in urging the State Board of Education to reject inclusion of an account of special creation in State-approved science textbooks.

A Statement Affirming Evolution as a Principle of Science

American Humanist Association

Reprinted with permission from *The Humanist*, January/February 1977 (Vol. 37, No. 1).

This statement was developed by a committee of the American Humanist Association including Isaac Asimov, Bette Chambers, Hudson Hoagland, Chauncey D. Leake, Linus Pauling, and George Gaylord Simpson. It represents a response to (a) the steady assault on the teaching of evolution in the public schools of the United States, and (b) the demand that the doctrine of biblical creation be given equal time. The original statement was signed by 179 scientists, educators and religious leaders.

For many years it has been well established scientifically that all known forms of life, including human beings, have developed by a lengthy process of evolution. It is also verifiable today that very primitive forms of life, ancestral to all living forms, came into being thousands of millions of years ago. They constituted the trunk of a "tree of life" that, in growing, branched more and more; that is, some of the later descendants of these earliest living things, in growing more complex, became ever more diverse and increasingly different from one another. Humans and the other highly organized types of today constitute the present twig-end of that tree. The human twig and that of the apes sprang from the same apelike progenitor branch.

Scientists consider that none of their principles, no matter how seemingly firmly established -- and no ordinary "facts" of direct observation, either -- are absolute certainties. Some possibility of human error, even if very slight, always exists. Scientists welcome the challenge of further testing of any view whatever. They use such terms as *firmly established* only for conclusions founded on rigorous evidence that have continued to withstand searching criticism.

The principle of biological evolution, as just stated, meets these criteria exceptionally well. It rests upon a multitude of discoveries of very different kinds that concur and complement one another. It is therefore accepted into humanity's general body of knowledge by scientists and other reasonable persons who have familiarized themselves with the evidence.

In recent years, the evidence for the principle of evolution has continued to accumulate. This has resulted in a firm understanding of biological evolution, including the further confirmation of the principle of natural selection and adaptation that Darwin and Wallace over a century ago showed to be an essential part of the process of biological evolution.

There are no alternative theories to the principle of evolution, with its "tree of life" pattern, that any competent biologist of today takes seriously. Moreover, the principle is so important for an understanding of the world we live in and of ourselves that the public in general, including students taking biology in school, should be made aware of it, and of the fact that it is firmly established in the view of the modern scientific community.

Creationism is not scientific; it is a purely religious view held by some religious sects and persons and strongly opposed by other religious sects and persons. Evolution is the only presently known strictly scientific and nonreligious explanation for the existence and diversity of living organisms. It is therefore the only view that should be expounded in public-school courses on science, which are distinct from those on religion.

We, the undersigned, call upon all local school boards, manufacturers of textbooks and teaching materials, elementary and secondary teachers of biological science, concerned citizens, and educational agencies to do the following:

--Resist and oppose measures currently before several state legislatures that would require creationist views of origins be given equal treatment and emphasis in public-school biology classes and text materials.

--Reject the concept, currently being put forth by certain religious and creationist pressure-groups, that alleges that evolution is itself a tenet of a religion of "secular humanism," and as such is unsuitable for inclusion in the public-school science curriculum.

--Give vigorous support and aid to those classroom teachers who present the subject matter of evolution fairly and who often encounter community opposition.

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Editor's Note: The above statement was signed by 179 scientists, educators, and religious leaders.

The sponsoring committee and authors were:

Isaac Asimov, Boston University School of Medicine,

Bette Chambers, American Humanist Association,

Hudson Hoagland, The Worcester Foundation for Experimental Biology,

Chauncey D. Leake, University of California at San Francisco,

Linus Pauling, Linus Pauling Institute of Science and Medicine, and

George Gaylord Simpson, University of Arizona at Tucson.

Religious Leaders' Views on the Theory of Evolution

In 1971-74 a controversy engulfed the California State Board of Education which involved the state adoption of textbooks. Specifically, during the adoption process for elementary (K-8) science textbooks, creationist groups demanded implementation of the Science Framework for California Public Schools. This framework called for mandatory inclusion of creationist doctrine in public school science textbooks. Throughout 1972 the controversy grew as opposing sides aired their views. One of the major confrontations of the year occurred at the November 9 public hearings held by the State Board. Both creationists and scientists had their say, but, as John A. Moore points out, "probably those most effective in urging the Board not to mandate the teaching of creationism as science were important representatives of Catholic, Jewish, Protestant, and Buddhist religions. These individuals made it abundantly clear that they did not regard the controversy as one between religion and science but as one between fundamentalist and science." ("Creationism in California," Daedalus, Summer 1974, Vol. 103, No. 3). Here are a few of the statements presented by religious representatives at that public hearing in Sacramento on November 9, 1972.

The Very Reverend C. Julian Bartlett,
Dean of Grace Cathedral, San Francisco

My name is C. Julian Bartlett. I am an Episcopalian by religious conviction and am Dean of Grace Cathedral in San Francisco, While I obviously have had theological training in Biblical religion, the Honorable Board should know also that I was graduated from Tulane University with a degree in Chemical Engineering. I appear before you, therefore, as a Biblical religionist whose education was in significant part oriented to the physical sciences. I have never believed that the theological dogmas essential to my religious convictions are, or have been at any time, in conflict or at variance with knowledge which has been discovered through the physical sciences. I go further. I state unequivocally that I readily "lay on the line" every theological *belief* which I hold--even the ultimate belief in a Deity--in exposure to the light of truth which may be discovered through investigation of the physical sciences. If at any time, *any* theological doctrine should be proven incorrect under the impact of scientific *knowledge*, I shall discard that theological doctrine.

In having that attitude, I share with innumerable other religionists essentially the intellectual stance of every reputable scientist of whom I have ever heard. In *true* science, every thesis, every theory, every so-called "law" is "on the line," subject to continuing testing before our ever-expanding body of knowledge.

All of this is essential and relevant to the subject at hand before this Honorable Board. You are fully aware that the creation myth-story set forth in the Book of Genesis was for many centuries considered by Christians and Jews alike as the reliable account, quite literally, of the origin of our physical environment and of the various forms of life, of whatever nature. That Biblical myth-story was but one of many such which were developed by primitive religions. Over 100 years ago modern science began to dismantle the superstructure of religious myth-stories or origins, and of the Genesis story in particular, by means of scientific investigation. In so doing, science rendered Biblical religion an inestimable service in that religion was thereby enabled to recover a simple truth about the Book of Genesis: i.e., that it is a religious and therefore theological document and not a scientific treatise.

Now, with specific reference to the final draft of the *Science Framework,* I wish to make the following statements:

1. By definition, this is to be the approved framework of a science curriculum in this state. There is, therefore, no appropriate place for any material to be included which does not rest on sound scientific knowledge and/or theory.
2. I am convinced that the controversial amendments to the *Science Framework* tentatively adopted by this Honorable Board are not scientific statements and therefore should be deleted in your final action.
3. I have confidence in and support the statement this Honorable Board has received from Professor Thomas H. Jukes of the University of California at Berkeley. (1)
4. If this Honorable Board decides that textbooks should include nonscientific theories and/or dogmas about creation and/or the origins of our physical environment and/or forms of life, such matters should be put in *appropriate* textbooks, not scientific ones.
5. I urge this Honorable Board to accept the advice of the distinguished State Advisory Committee on Science Education, which body was appointed by this Board for that specific purpose.
6. As I stated publicly in 1969 when the news of the amendments were first publicized, I would find your final approval of those amendments "incredible, appalling and preposterous."

(1) A copy of the remarks by Professor Jukes appears at the conclusion of this series of statements by religious representatives.

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Pastor Robert Bulkley, Portalhurst Presbyterian Church, San Francisco

My name is Robert Bulkley, Pastor of Portalhurst Presbyterian Church in San Francisco, and Protestant co-chairman of the San Francisco Conference on Religion, Race and Social Concerns. This organization for which I apeak today is sponsored by the Archdiocese of San Francisco, the San Francisco Council of Churches, and the Board of Rabbis of Northern California. It concerns itself with those public matters to which the religious voice can speak and in which the religious and spiritual position of our three faiths have meaning.

Such a matter, we believe, is the adoption of science textbooks for use in California schools. We understand that proposals are being made that such textbooks include as an alternative to the theory of evolution the special creation theory that seems to be implied in the early chapters of Genesis.

As a group of clergymen and laymen connected with churches and synagogues, we deem such proposals to be based upon a profound misunderstanding of the respective roles of science and religion. They confuse the objective findings of science that creation has occurred by means of an unimaginably long and complex evolutionary process, and the insight of religion that God is creator, an insight which does not pretend to have knowledge of *how* He has gone about His work of creation and which certainly does not depend for its truth on the adoption of the specific methods outlined in either the first or the second chapters of Genesis. We believe it is the role of science to ferret out the objective facts and to develop theories which as completely as possible will account for those facts. If there is substantial division in the scientific community as to what the facts are or as to what theories will most adequately account for them, this division clearly should be reflected in the textbooks. But we do not believe it is the function of science to proclaim philosophies or theologies, either to affirm that God is the creator and that all things are accomplished by His design, or to affirm that there is no God and that all is the result of chance. We do not conceive it to be the function of science or of science textbooks even to deal with questions like these.

We are also concerned with these matters because of their implications for the historic American principle of separation of Church and State. While we are not opposed to the teaching of objective facts *about* religion in the public schools in a context which does not address itself either to the acceptance or to the rejection of any particular religion or of religion in general, including, we presume, the religion of secularism, we are profoundly opposed to the teaching of religion and religious beliefs as a serious breach in the wall of separation of Church and State and therefore undoubtedly unconstitutional. To deal with the biblical account of creation in a course on science in the public schools appears to us to be just that.

As religious men and women and as men and women committed both to social justice and to the democratic process, we of the San Francisco Conference on Religion, Race and Social Concerns respectfully urge you to choose science textbooks which deal with science and which do not venture into the fields of theology and religion.

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Rabbi Amiel Wohl, Congregation B'nai Israel, Sacramento

I come from Judaism, a religious tradition, which, at the outset of its history, placed the cosmogony which we know as the Creation Epic in its sacred texts. To these ancient Hebrews living in that pre-scientific period of history, the important concept was of a Perfect Unity, a Creative Source who brought the world into being. The purpose of the account was to give the people of that day the source for the miracle of life that coursed through them. The authors of scripture were seeking to explain the origin of life as we have it.

In our Jewish religious traditions today, we find in that account great moral power, eloquence and beauty. We do believe that God is the Creator; that He did exist before the Creation, even as He exists now and will exist forever and ever.

We do understand that the tools of scientific inquiry which man has used since the Renaissance are perfectly appropriate and applicable in the human search for truth. We welcome all revelations, whether coming from ancient annals, or the seers of our own day.

But, as for the teaching of science, we would never purport to place the Creation Epic as a scientific theory of creation. We understand it as a theological statement. We think it would be perfectly appropriate to refer to the Creation Epic as it would be fitting to mention other important cosmogonies that have to do with the origin of the world that have occurred in other memorable and viable cultures. We would not like to impress our theory as one that bears the test of scientific inquiry, but would rather let it stand as it already does in the history of thought, anthropology and religious study. It would be confusing to call science, religion, or religion, science, or to confuse the two in the study of pure inquiry.

From the earliest period forward, our Jewish faith has never been weakened or threatened by the new knowledge. The majesty and mystery remains. The truth of Adam and Eve stories, or any other Biblical tales, does not rise or fall on their scientific demonstrability, but rather on their moral and symbolic teaching.

In the public domain and public schools, we have to be very careful to avoid any particular group sectarian ideas.

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Sister Anne Chester, Consultant in Education, Catholic Schools, Diocese of Sacramento

I wish to address myself to the controversial paragraphs inserted on page 106 in the *Science Framework for California Public Schools (1969)*, which would require the schools to include matter based on religious belief in a science curriculum. Specifically, I am concerned with the implications these two paragraphs have for the state adoption of elementary science textbooks. I wish to focus on two aspects: the problem this stand poses for scholars in both science and theology; and the weaknesses the requirement would foster in science teaching and learning in the schools.

(1) The evolutionary theory is as open-ended as the atomic theory; all scientific hypotheses must be open to correction in the light of newly discovered facts. However, it is inadvisable to stretch theological data in order to "fill in" the areas of the evolutionary theory which are still incomplete.

(2) Most of the circulated material on creation theory currently being proposed for inclusion in science texts gives little, if any, recognition to the profound advances in Scriptural exegesis of the past fifty years. These advances have been accomplished through the concerted efforts of scholars of many faiths. The majority of reputable Scripture scholars and theologians find the creation theory material unacceptable as presented.

(3) A requirement, such as proposed, to include matters of religion in a general science curriculum on the elementary and secondary level, is poor pedagogy. It necessitates a careful in-depth study of methods used by scientists and theologians, as well as background in history, sociology, and literature. In a public school an unbiased and balanced presentation of the plurality of religious opinions regarding the origin of life would be demanded. Such a study would clearly be interdisciplinary and should be identified as such.

(4) While one might affirm the value of including such a study on late secondary or college levels, the sophistication of the content makes it inadvisable before this time. The *Science Framework* correctly points out: "If the curriculum is to promote intellectual achievement, it needs to be organized and sequenced in terms of the growth and developmental characteristics of young people." As is evident in the materials of one proposed series, compromise might result in presenting content far beyond the students' comprehension. The consequence could be confusion, ridicule and rejection by the students.

I commend the Commission for the selections they are presenting for the Board's consideration. I believe that those series and the reusable materials adopted should incorporate sound educational psychology, accurate presentation of scientific facts, and the excitement of man discovering the marvelous universe he lives in through *one* of the many avenues of knowledge.

The adoption process already results in outdating a science book three years before releasing it to the classroom. Hopefully it will not be further hampered by an issue extraneous to science teaching and learning.

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Rev. James F. Church, Assistant Superintendent, Catholic Schools, Sacramento

I would like to present three statements regarding Evolution and Immediate Creation in the Science Text adoptions.

(1) Religion is out of place in a science book. The objects and instruments of science and religion are too different. To include religion in a

science text appears to be searching for God with a microscope or a telescope. The only end-result will be a ridicule of religion and the course. In the past science texts and teachers have been quite saracastic when the book of Genesis was introduced into a science class. The theory misentitled "Creationism" is not a science theory but a biblical one. The term "Creationism" is a prejudicial simplification for "Instantaneous" or "Immediate" Creation in opposition to the more up-to-date biblical theory of Evolution under the direction of God. Teaching and explaining the Bible has its place and importance, but not in a science classroom.

(2) Historically, attempts to combine Theology and Science have proven disastrous. The Bible was not written to provide scientific data; and Science attempts to answer the questions "what" and "how", not the "who" of origination. The Catholic Church is approximately ten times older than the United States of America and has been in the business of educating almost twenty times longer than the State of California. In this period fingers have been burned by this question of religious intervention more than once.

Experience should teach us not to repeat the same mistake. The scientific communities are very slow to forgive or forget dogmatic errors which oppose them. They remember them for centuries. Sincere and well meaning leaders in the past have opposed science under the guise of protecting "classical", "historical", and "biblical" teachings. Their faux pas are ridiculed for generations. It is conceivable that the State of California will be remembered more for a repetition of the "monkey-trial" error rather than the great space achievements and Nobel prizes of the California scientific community.

(3) The essence of the problem under discussion in this context seems to be one of religion rather than science. Religion has a positive place in educating for values, character and citizenship. Perhaps a new assessment of the place of religion in the public schools is needed. A committee or commission should look into this. At any rate, if religion is to be inserted in the curriculum, it does not belong in a science class. A class in literature could study the Bible; a sociology class could look at the effects of religion on mankind; history could take note of religion's place in our past, etc. None of these would give a true view of religion or God but they would be a much better first step for bringing God into our schools. Science is the study of the works of God as they are. This is without commercials and none are needed. No one has to say "This rainbow is brought to you by Almighty God". A masterpiece presented can be investigated in itself. If someone does not notice the signature upon a masterpiece, let them appreciate the creation in itself. Later they can come to learn of the Originator. Science should be permitted to do its work in its own way.

Your advisory committee on science has rejected the insertion of the "Immediate Creation" theory into the science criteria and curriculum. They deserve to be congratulated and should be heeded.

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Rev. Hogen Fujimoto, Director, Department of Buddhist Education, Buddhist Churches of America

I speak for the Buddhist Churches of America, a national organization of the Jodo Shin School of Buddhism consisting of 60 independent temples and 40 branches located throughout the continental United States (not including the State of Hawaii) with National Headquarters in San Francisco. Besides the organization I represent, the views of the untold number of Buddhists of other denominations and unattached Buddhists would concur with the viewpoints I present.

The very basic principle of Buddhism is that the whole of the Universe functions strictly in accordance with the law of Causality, i.e., the law of cause, condition, and effect. Nothing happens without causes and sub-causes, and furthermore, the effect is again a cause to bring about further effects. In the complexities of causes and sub-causes, one cause cannot be isolated and hidden within the myriads of sub-causes or conditions. For this reason, the one cause concept such as the Divine Creation cannot be accepted by Buddhists. To the Buddhists, the whole of the Universe is constantly in the process of creation as we note in the changing world we live in today.

When Sakyamuni Buddha was questioned about the beginning, he maintained a noble silence. In other words, the question was not of significance or pertinence to him. Whether we came about through creation or evolution, it would not affect the fact that we are here now a single bit. The question, rather, is that we are here now, we have problems, wherein lies the answer to existence! Buddha then proceeded to reply by the parable of the poison arrow. Suppose you were hit by a poison arrow. Your immediate question would be to get that poison out of your system and not to be inquiring as to what angle was it shot, who manufactured it, to what tribe did it belong, etc. Before you can arrive at an answer, your life will come to an end.

It is my firm conviction that the school is not the proper place to teach Divine Creation. It belongs in the church or in the family. The question of the beginning is beyond human intellect to grasp and, therefore, should not be incorporated in the school curriculum.

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Editor's Note: Several religious representatives presented their viewpoints to the California State Board of Education during the public hearings held on November 9, 1972. Many held to the position that the best avenue to follow was the traditional separation of religious doctrine from scientific information in public school textbooks.

In Reverend C. Julian Bartlett's presentation, special attention was called to a statement by Professor Thomas H. Jukes of the University of California at Berkeley. That statement appears below.

A Statement by Thomas H. Jukes, Ph.D., Space Sciences Laboratory, University of California, Berkeley.

My name is Thomas Jukes. I am a professor at the University of California. I am interested in the teaching of Children; my parents were both elementary school principals and my wife and two daughters are teachers in the California grade school system. I am a student of evolution.

I am opposed to the proposed revisions in the grade school science texts, such as the statement that "all features and characteristics now existent were part of original special creation." This is contrary to evidence from the fossil record, from embryology, and from biochemistry. A hen's egg has no "features and characteristics" of the chicken that emerges from it in three weeks. Any embryo reveals much of the evolutionary history of its species as we watch it develop. All of us in this room had fish-like gill slits before we were born.

The statement that "existing characteristics were part of original special creation" does not make scientific sense and does not belong in a science text book.

The proposed revisions repeatedly state that conclusions of science are only those of "some creationists" and hence represent a divided opinion. This is erroneous and confusing. The usefulness of science depends on the acceptance of good evidence. We no longer believe that mud can give rise to frogs.

I object to the inclusion of the opinions by Mr. Grose in the *Science Framework*. [When the *Science Framework* was submitted to the California

State Board of Education, the framework as originally drafted was modified by inclusion of two paragraphs submitted by Vernon Grose, who was not one of the authors of the framework.] Grose states, for example, that the regular absence of transitional forms may be best explained by a creation theory. Transitional forms are not absent. We can detect them by using the new procedures of molecular evolution, discovered within the past few years.

Chemical studies of DNA and proteins in different organisms have shown that all forms of life that have been examined are related to each other by a continuous transition of molecular structures. A single drop of blood contains chemical information telling us that we are closely related to the chimpanzee and gorilla, not so closely to horses and cattle, and more distantly, step by step, to kangaroos, chickens, frogs and bony fishes. This information is measurable in percentages. The new knowledge extends much further than the study of fossils. Examination of another protein, cytochrome, shows that human beings are related to wheat plants, yeast cells and bacteria. The probabilities of this relationship can be computed and shown to be in excess of one billion chances to one in favor of descent of all animals and plants from a common ancestor. All proteins that have been analyzed fit this same pattern, and so does the genetic DNA itself. One of the first books explaining this was *The Molecular Basis of Evolution* published in 1959 by Dr. Christian Anfinsen, who last month received the Nobel Prize for chemistry. This conclusion contradicts the proposal by Mr. Grose in the paragraphs he had inserted into the *Science Framework*.

We now have the tools in the laboratory and the computer to calculate the chemical make-up of ancestral forms. A wholly majestic spectacle of unified evolution and the kinship of living creatures emerges from modern scientific findings. No "dualism" exists, in spite of Mr. Grose's allegations in the *Science Framework*. As I said in 1967, "We perceive the evolutionary process as a part of the great natural laws that govern all matter. And as we gaze upon ourselves as human beings, we see that we have been given the intelligence to discover the secrets of nature by dint of work and study. One of these secrets that man has discovered is that of evolution." Scientists do *not* teach that "the universe, life and man are simply 'accidents' that occurred by fortuitous *chance* without cause." The teaching of evolution, like that of other branches of science, emphasizes cause and effect.

The Grose opinion represents an attempt to introduce religious matter into textbooks of science. Discussions of creation hypotheses belong in the area of comparative religions. Various theories of creation may be found in many religions and cultures. Their exposition is not part of the function of school science textbooks. One of the proposed textbooks omits the biography of Dr. Leakey that appears in the national version. Dr. Leakey studied the origin of man in fossils in Africa. The proposed revision contains, instead, Michelangelo's painting of the Creation. This is art, not science, and the suggestion of a white creator giving life to a white first man is ethnically dubious.

[One member of the Board] states that Kerkut's theory of evolution is the best current explanation. Kerkut's book contradicts known facts of science, such as the participation of only 20 amino acids in protein synthesis. [This member] also wrongly states that "science classically ignores...value systems, morals, art and poetry." I recommend he read the lives of Pasteur, Banting and Borodin. To say that science ignores value systems and morals is a slur on many great scientists who have devoted their lives to human betterment through agriculture, through bacteriology and in the field of medicine.

I urge the Board to adopt the *Science*

Framework without inclusion of the opinion by Grose. I urge against any advocacy of the creation theory in science textbooks.

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SCIENCE FRAMEWORK FOR CALIFORNIA PUBLIC SCHOOLS

During the period 1967-69 a *Science Framework for California Public Schools* was developed by the State Advisory Committee on Science Education at the direction of the California State Board of Education. Members of the Advisory Committee included distinguished and well-known scientists and educators.

The *Science Framework* assessed the need for science curriculum reform and developed a philosophical position on science education. It addressed itself to goals and terminal objectives for kindergarten through grade twelve, determined optimum conditions for learning, discussed revising and implementing curricula, and concluded with selected references and three appendixes.

The final draft of the 148 page *Science Framework,* having received approval of the California State Curriculum Commission, was presented to the State Board of Education on October 9, 1969. Approval was withheld. Board member John Ford stated: "I think we would be amiss if we did not include the theory of creationism in teaching the origin of the species." Board member Thomas Harwood agreed with Ford; he stated: "I believe in the creation theory." Adoption was withheld and the *Science Framework* was temporarily shelved.

On October 14, 1969, The *Los Angeles Times* editorialized in favor of adoption of the *Science Framework*. The *Times* pointed out that the teaching of evolution in the state's public schools had been declared constitutional in 1963 by the California Attorney General's office, that the creation concept could be presented to students in courses other than science, and that "the only proper approach to the teaching of science" would be found in supporting the State Advisory Committee's decision to stick to supportable scientific conclusions. The editorial concluded: "We hope that the State Board of Education will concur when they reconsider the science guidelines next month. After all, one need not be an atheist to accept the theory of evolution and the mass of scientific evidence that supports it."

In response to the above editorial, Vernon Grose prepared a 13 page personal viewpoint. This personal opinion was presented at a meeting of the State Board of Education on November 13, 1969, by Grose, a member of the audience. The Board thereupon deleted two sentences of the original *Science Framework* draft and inserted two paragraphs as prepared by Grose. The Board then adopted the revised framework.

The Grose opinion, as inserted into the *Science Framework,* stated:

> All scientific evidence to date concerning the origin of life implies at least a dualism or the necessity to use several theories to fully explain relationships between established data points. This dualism is not unique to this study but is also appropriate in other scientific disciplines, such as the physics of light.
> While the Bible and other philosophic treatises also mention creation, science has independently postulated the various theories of creation. Therefore, creation in scientific terms is not a religious or philosophic belief.
> Also note that creation and evolutionary theories are not mutual exclusives. Some of the scientific data (e.g., the regular absence of transitional forms) may be best explained by a creation theory, while other data (e.g., transmutation of species) substantiate a process of evolution.

This personal viewpoint from a member of the audience became the basis for years of turmoil over science textbook adoptions in California.

An arduous effort to resolve the matter finally ended on March 14, 1974. On that date the California State Board of Education formally adopted a revision for paragraphs 2, 3, and 4 of page 106 in the *Science Framework*. The two objectionable paragraphs authored by Grose were replaced by the following statements:

> Interactions between organisms and their environments produce changes in both. Changes in the environment are readily demonstrable on a short-term basis; i.e., over the period of recorded history (circa 5,000 years). These changes have been inferred from geologic evidence over a greatly extended period of time (billions of years), although the further back we go, the less certain we can be. Prehistoric processes were not observed, and replication is difficult. During the past century and a half, the earth's crust and the fossils preserved in it have been studied intensively by scientists. Fossil evidence shows that organisms populating the earth have not always been structurally the same. The differences are consistent with the theory that anatomical changes have taken place through time. The process of change through time is termed evolution. The Darwinian theory of evolution postulates a genetic basis for the biological development of complex forms of life in the past and present and the changes noted through time.
>
> The concepts that are the basic foundation for this theory are (1) that inheritable variations exist among members of a population of like organisms; and (2) that differential successful reproduction (i.e., survival) is occasioned by the composite of environmental factors impinging generation after generation upon the population. The theory is used to explain the many similarities and differences that exist between diverse kinds of organisms.
>
> The theory of evolution, its limitations notwithstanding, provides a structural framework upon which many seemingly unrelated observations can be brought into more meaningful relationships. Biologists also have developed, from experiments and observations, hypotheses concerning the origination of life from nonliving matter (e.g., the heterotroph hypothesis). Philosophic and religious considerations pertaining to the origin, meaning, and values of life are not within the realm of science, because they cannot be analyzed or measured by the present methods of science.

Early in 1977 trustees of the Dallas (Texas) Independent School District approved the use of a creationist biology textbook. Opposition to this action included the following statement, authored by Catholic, Protestant, and Jewish spokesmen.

We, the undersigned, are strongly opposed to the DISD Board's approval of the textbook, *Biology: A Search for Order in Complexity,* as mandatory supplementary reading in high school courses in biology.

The principal reason for our opposition to the Board's action is that this textbook is different from other biology textbooks primarily, if not exclusively, because it is expressly and avowedly organized in terms of sectarian religious beliefs. Instead of being organized for the purpose of introducing the beginning student of biology to the current state of that science with respect to its data, methods, and generally accepted hypotheses and theories, this book is expressly organized so as to present and defend the religious beliefs of the Creation Research Society, whose Textbook Committee is responsible for its preparation. Consequently, to make use of this book as a textbook in courses in biology--as distinct, say, from using it as a document to be studied in courses in recent American social or cultural history--is, in direct proportion to the nature and extent of its use, to disseminate among students in those courses the same sectarian religious beliefs.

That the beliefs in terms of which the whole structure and contents of the book are organized are, in fact, religious beliefs, is clear enough simply from the express acknowledgements to this effect in the Preface. According to the position set forth there, "discussion of origins is not, strictly speaking, science....therefore, the solution to the problem of origins is simply impossible by scientific means" (xvii). To explain how things as we now know them got to be as they are "necessarily entails a philosophical viewpoint regarding origins." But "there are essentially only two philosophic viewpoints or origins among modern biologists--the doctrine of evolution and the doctrine of special creation" (xvii). The whole purpose of the book, however, is to establish the reasonableness of the second of these philosophic viewpoints, which is undoubtedly a religious viewpoint. Thus we are told, summarily, "*Biology: A Search for Order in Complexity* is in the first place a textbook of biological science....At the same time, it is explicit throughout the text that the most reasonable explanation for the actual facts of biology as they are known scientifically is that of biblical creationism" (xxiii).

But now anyone at all acquainted with modern biology as it is typically institutionalized in universities and research centers as well as in the professional associations of biologists and in the books and journals in which they publish their findings will recognize at once that this position is so far from representing the current state of that science as to be, in fact, eccentric. For by far the vast majority of modern biologists, the evolutionary account of biological origins is not all a philosophic viewpoint but is a strictly scientific hypothesis or theory and, therefore, logically incomparable with so-called biblical creationism. Consequently, to suggest, as the book does, that modern biologists recognize two explanatory accounts--the doctrine of special creation as well as the doctrine of evolution--is to give a wholly misleading impression of the current state of biological science. The plain truth of the matter is that, except for the vanishing fringe represented by the Creation Research Society, the whole idea that biblical creationism could even conceivably function to explain biological origins as the hypothesis of evolution explains them is dismissed as an anachronism. Therefore, but for the existence of a specifically religious group such as the Creation Research Society, which is constituted, not by its commitment to open-ended scientific research, but, rather, by its commitment to certain fixed religious beliefs, there would never have been such a textbook as the book in question.

The further and more important point, however, is that the religious beliefs in terms of which the whole book is organized are, as a matter of fact, sectarian--in the sense that they are beliefs accepted by the members of some religious groups but rejected by the members of others. If the idea that the doctrine of special creation is an explanatory account of logically the same type as the hypothesis of evolution is typically dismissed as an anachronism by modern biologists, the same is true of modern theologians. In fact, there is now a widespread consensus among theologians of all our major religious traditions, Protestant, Catholic, and Jewish alike, that the biblical accounts of creation are profoundly misunderstood if they are taken to belong to the same logical type as scientific explanations of origins such as the hypothesis of evolution. For those to whom we owe it, "to tell the story of creation was to give an account of what the world in which man lives is like. The story was not intended to give a factual explanation of how the world came into existence, or to define why is has the character it does, but to show *the right way of understanding the world,* so that men and women might know how to live and act within it." (Denis Baly, *God and History in the Old Testament* (New York: Harper & Row, 1976), p. 108). Accordingly, to treat the properly theological doctrine of creation of all things out of nothing by God as though it could even conceivably conflict with the evolutionary explanation of biological orgins is either to exalt the doctrine of evolution to a logical status that no biologist as such would think to claim for it or else to reduce the doctrine of creation to a logical status far below that which it is bound to have for the clear-headed religious believer.

So, at any rate, would innumerable theologians and religious believers today want to argue. And, to recognize that this is, in fact, the case is to realize why the beliefs of the Creation Research Society are, precisely, sectarian religious beliefs. But, then, there cannot be the least question in any informed mind that to approve the textbook that the society has prepared for use in high school courses in biology is to approve the dissemination among the students in those courses of these same sectarian religious beliefs.

So far as we are concerned, then, at stake in the Board's approval of this book is not only the integrity of the scientific education of the youth of Dallas but also their right as students in a public school system to an education that is free from sectarian religious bias.

Reverend Wilfred Bailey
Casa View United Methodist Church

Rabbi Jack Bemporad
Temple Emanu-El

Reverend Mark Herbener
Mount Olive Lutheran Church

Reverend Frank Mabee
Midway Hills Christian Church

Reverend Bob McCown
Catholic Chaplain, Jesuit H.S.

Professor Schubert Ogden
Southern Methodist University

Dr. Ben Oliphint
First United Methodist Church

Reverend William H. Tiemann
St. Marks Presbyterian Church

Rabbi Max Zuker
Congregation Tiferet Israel

* * * *

The Catholic, Protestant, and Jewish leaders listed above were all residents of Dallas, Texas at the time they prepared and signed this statement.

The BSCS Position on the Teaching of Biology

Addison E. Lee

Reprinted with permission from the *BSCS Newsletter,* Number 49, November 1972.

From its inception the Biological Sciences Curriculum Study recognized the necessity of including the theory of evolution as a major unifying theme in general biology curricula. This theme can be found throughout all editions of the well-known blue, green and yellow versions. The author has nearly two decades of involvement with BSCS activities and programs.

The Biological Sciences Curriculum Study program began in 1959 amid considerable debate about the approach to be taken in the teaching of biology. Should it be molecular, organismal, developmental, ecological, or other? Should it include one textbook or several? How much and what kind of attention to laboratory work should be given? Amidst all these debates, however, it was an early consensus that certain themes should be included in all biology programs, no matter what approach is selected, and whatever attention may be given to various details. These themes were identified and have consistently pervaded the several approaches and different materials developed by the BSCS during the past twelve years. They are:

1. Change of living things through time: evolution
2. Diversity of type and unity of pattern in living things
3. The genetic continuity of life
4. The complementarity of organism and environment
5. The biological roots of behavior
6. The complementarity of structure and function
7. Regulation and homeostasis: preservation of life in the face of change
8. Science as inquiry
9. The history of biological conceptions

It should be noted that these unifying themes were identified and accepted by a large group of distinguished scientists, science teachers, and other educators. And although members of this group represented many interests, specialities, and points of view, there was and has continued to be general agreement concerning the importance, use, and nature of these themes.

It should also be noted that evolution is not only one of the major themes but is, in fact, central among the other themes; they are interrelated, and each is particularly related to evolution.

The position of the BSCS on the importance of evolution in teaching biology has been clearly stated in both the first (1963) and second (1970) editions of the *Biology Teachers' Handbook:*

> It is no longer possible to give a complete or even a coherent account of living things without the story of evolution.
>
> On the one hand, many of the most striking characteristics of living things are *products* of the evolutionary process. We can make good sense and order of the similarities and differences among living things only by reference to their evolution. The relations of living things to the particular environments in which they live, their distribution over the surface of the earth, the comings and goings of their parts during development, even the chemistry by which they obtain energy and exchange it among their parts--all such matters find illumination and explanation, in whole or in part, from the *history* of life on earth.
>
> On the other hand, another great group of characteristics of living things can be fully understood only as the *means* and *mechanisms* by which evolution takes place. There are first, and conspicuously, the events of meiosis and fertilization, universal in sexual reproduction. It is only in terms of the contribution of these processes to the enhancement and sorting out of a vast store of heritable variation that we make sense of them. The same point applies to the complex processes that go under the name of mutation. Similarly, we see everywhere the action and consequences of natural selection, of reproductive isolation of populations, of the effects of size and chance on intrabreeding groups.
>
> Evolution, then, forms the warp and woof of modern biology.....(1)

Evolution is a scientific theory in the sense that it is based on scientific data accumulated over many years and organized into a unifying idea widely accepted by modern biologists. The BSCS is concerned with any scientific theory relevant to the biological sciences that can be dealth with in terms of scientific data accumulated and organized. It is not, on the other hand, concerned with religious doctrines that are based only on faith or beliefs, nor does it consider them relevant to the teaching of biological science.

The BSCS program was carried through an extensive tryout period during its early development; feedback and input from hundreds of scientists and science teachers was used in the initial edition that was made available to biology teachers in the United States. A revised second edition of the three major textbooks produced has been published, and a revised third edition is nearing completion. In spite of efforts of various groups to force changes in the content of the texts by exerting pressures on textbook selection committees and on local and state governments, throughout the last twelve years the BSCS position on using the unifying themes of biology remains unchanged.

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(1) BSCS, *Biology Teachers' Handbook,* Joseph J. Schwab (supervisor), John Wiley and Sons, New York, 1963. BSCS, *Biology Teachers' Handbook,* Second Edition, Evelyn Klinckman (supervisor), John Wiley and Sons, New York, 1970.

Evolution as the Central Theme of Biology

G. Ledyard Stebbins

Reprinted with permission from the *BSCS Newsletter*, Number 49, November 1972.

A distinguished professor of genetics and member of the National Academy of Sciences and the American Philosophical Society emphasizes the centrality of evolution to biology. An expansion of these brief remarks can be found in his books on variation and evolution in plants, and on the processes of organic evolution.

The great majority of life scientists now agree that there is only one central theme about which all the facts about the millions of diverse kinds of organisms can be arranged. This is the generally recognized theory that modern species of animals, plants, and microorganisms are all descended from a continuous line of ancestors that stretches back billions of years to the time when life first appeared upon the earth. They have evolved from these ancestors at different times, at different rates, and in different directions. Biologists who know the facts regard the probability that evolution has occurred as about equal to the near certainty that in the past, before written records existed that modern men can read directly, men had formed great empires such as those of ancient Egypt, Sumer, Babylon, and Crete. The evidence for the origin of major groups or distinctive kinds of organisms, one from the other, is of the same kind and equally strong as the evidence which has enabled archeologists to reconstruct the civilizations of these ancient empires.

The only alternative to evolution that is seriously proposed to explain the origin of different kinds of animals, plants, and mankind is special creation. Scientists cannot deal with this alternative, since it is not science. Scientists build and test hypotheses; the "creationists" would have us accept special creation on faith, if they have, to their satisfaction, gathered enough "evidence" to cause them to doubt the occurrence of evolution. The belief in special creation is untestable. Those who advocate its inclusion in the science curricula of our public schools do not permit scientists to criticize or examine it. One cannot question the ability or the way in which a supreme being could have created the millions of different kinds of living organisms that exist on the earth.

Two of the objections which are most commonly raised by "creationists" to modern evolutionary theory are first, that transitional fossils between major groups of animals do not exist. This statement is erroneous. In a letter to me dated August 4, 1972, Professor A. S. Romer of Harvard, one of the world's leading paleontologists, has stated: "...over the course of the past century more and more transitional forms have been discovered. If we consider the group of vertebrates, in which we are all most specifically interested,...for all higher groups transitions are definitely known." Another authority of equal eminence, Professor G. G. Simpson, states (letter of August 1, 1972): "Literally thousands of transitional forms are known, and more are discovered every year."

A second objection made by the "creationists" to modern evolutionary theory is that biologists can not explain the origin of life. This statement is also erroneous. Several experiments have shown that the basic molecules of which living organisms consist can be synthesized from compounds that were almost certainly present on the primeval earth. The methods of synthesis imitate processes that could very probably have taken place when a terrestrial environment favorable for life first appeared. The arrangement of these molecules into functional systems that were self-reproducing, and their evolution finally into the first cellular organisms, can be explained by processes of chemical mutation, recombination, and natural selection similar to the processes that have been experimentally demonstrated to be responsible for change of micro-evolutionary order in contemporary organisms. Experiments by biochemists have shown that these processes can operate to produce progressive change in acellular systems similar to the processes that are postulated to have preceded the development of cellular forms of life.

The only sound way to teach biology as a scientific discipline in the contemporary modern world is to emphasize evolution as a basic explanation for origins.

Science, Biology, and Evolution

Bruce Wallace

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In this brief but thoughtful statement, the author examines the centrality of the theory of evolution to the discipline of biology. The nature of a scientific theory is examined; the usefulness of the theory of evolution is discussed; and the essential quality of a testable theory of evolution to biology is illustrated. Wallace is a geneticist at Cornell University.

"Science," according to Karl Pearson, "consists of the classification of facts, the recognition of their sequence and relative significance." The facts of different sciences are of different sorts; nevertheless, the procedures of all sciences are much alike: Observations are made and these are fitted into a conceptual pattern that not only reveals their interrelations but also predicts the nature of other observations as yet unmade. Should dissimilar patterns serve equally well to explain past observations, the accuracy of their predictions will determine which is finally kept; the others will be discarded as historic relics. The word "pattern" as I have used it here is much like "theory" in ordinary scientific parlance.

"The cornerstone of the scientific method is the postulate that nature is objective." Those are the words of Jacques Monod. He continues, "[Science] required the unbending stricture implicit in the postulate of objectivity----ironclad, pure, forever undemonstrable." And, later, "...the postulate of objectivity is consubstantial with science; it has guided the whole of its prodigious development for three centuries. There is no way to be rid of it, even temporarily or in a limited area, without departing from the domain of science itself."

The biological sciences are not exempt from the strictures that confine science and scientific methodology. The observations of some biologists may be unusually complex, it is true. Nevertheless, these observations require classification and explanation. Explanations arise from the conceptual patterns into which observations are fitted. In biology there are many such patterns. Most obvious, perhaps, are those that lead to taxonomic classification. Others encompass the aggregations of diverse organisms into ecological communities. Still others are conceived as the biologist discerns the developmental sequences of individual plants or animals of all species. Beneath each of these gross patterns are still others that take form as their elements are revealed by microscopic or chemical analysis. In recent decades these techniques have been extended to the electron microscope and, through the wizardry of biochemistry and the use of radioactive isotopes, to molecular biology.

Within each branch and sub-branch of their science, biologists strive to organize their observations into comprehensible patterns--patterns that permit the mind to grasp and retain the most information with the least effort. Patterns that permit the individual to make predictions and to test hypotheses.

As more and more facts are organized, the boundaries between different branches of biology merge. Genetics is one example. From a study of abstract ratios, it has evolved and expanded in two directions: on one hand, it has become a search for an adequate "home" for the gene; on the other, it seeks to understand the development and functioning of the individual. As another example, ecology is no longer merely an efficiently organized natural history; the flow of energy and matter within and through natural communities is now the concern of many ecologists. Within this abstract realm, they treat both species and individuals as minor components of larger schemes. They can now describe complex ecological systems without the need to specify the endless detail that would otherwise be necessary.

Because of its complexity, biology encompasses not only a myriad of patterns, but also patterns of patterns. The sequential stages of the embryonic development of many different organisms are similar. Why? The individual biochemical pathways of different organisms are similar. Why? The genetic material of all known organisms consists of nucleic acids. Why? Many persons voice despair at the prospect of ever understanding the "small" biological problems, and, in their despair, they postulate the existence of vital forces and vital substances. These forces and substances are endowed with precisely those properties that are needed to explain troublesome observations. Problems, in a sense, are solved by fiat. These persons, to quote Monod, have departed from the domain of science. Today, many past instances of despair have been resolved. The Watson-Crick model of DNA, for example, has made the gene an object of precise analysis rather than of bizarre speculation, as it once was.

Evolution is the theory that purports to explain patters of patterns within the biosphere. From the genetic code, to genetic material, to biochemical pathways, to developmental patterns, to similarities of morphological features, to resemblances between plants and animals of the past and present, to the intricate relationships between members of ecological communities--in every instance the theory of evolution serves to make understandable the "sequence and relative significance" of innumerable observations. There are those who would depart from the domain of science and rely, instead, on supernatural explanations for these patterns of patterns. Unfortunately, such "explanations," if accepted, would stifle the investigation of all biological problems because, in explaining evolution, they would explain equally well all subsidiary problems. Thus, although there may be facts of the living world that are not yet easily accounted for under the theory of evolution as it is now accepted by most biologists, a theory of evolution that generates predictions and testable hypotheses is essential to biology. "There is no way to be rid of it, *even tentatively or in a limited area...*" Such are the words of Monod and such is the need for a scientific theory of evolution. A theory of evolution that is testable by observation and experimentation is imperative if biology is to remain a science.

On Giving Equal Time to the Teaching of Evolution and Creation

John A. Moore

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The author, a professor of biology at the University of California, Riverside, suggests how a teacher might possibly carry out the stipulations of the Tennessee law in an honest and competent way. The assumption is made that one would do this as a teacher of science, not as an advocate of some religious doctrine, and only the canons of scientific and scholarly procedures would be employed.

On April 30, 1973, Senate Bill 394, having been passed by an overwhelming majority of both houses of the General Assembly of the state of Tennessee, became law. The new law, which to some extent replaced the antievolution law that was repealed only in 1967, reads in part:

> Any biology textbook used for teaching in the public schools, which expresses an opinion of, or relates to a theory about origins or creation of man and his world shall be prohibited from being used as a textbook in such a system unless it specifically states that it is a theory as to the origin and creation of man and his world and is not represented to be scientific fact. Any textbook so used in the public education system which expresses an opinion or relates to a theory or theories shall give in the same textbook and under the same subject commensurate attention to, and an equal amount of emphasis on, the origins and creation of man and his world as the same is recorded in other theories, including, but not limited to, the Genesis account in the Bible...The teaching of all occult or satanical beliefs of human origin is expressly excluded from this act...Provided however that the Holy Bible shall not be defined as a textbook, but is hereby declared to be a reference work, and shall not be required to carry the disclaimer above provided for textbooks... This Act shall take effect upon becoming a law, the public welfare requiring it.

Similar bills have been or are being considered by the legislatures or departments of education of Georgia, Michigan, Washington, California, and Colorado, but only Tennessee's has become law.

When teachers of science are confronted with a situation of this sort, a variety of responses might be expected. Some teachers might welcome the possibility of being able to present their own religious beliefs to their students. Others might avoid the problem by omitting all references to scientific data and hypotheses about the origin and evolution of the world and its inhabitants. This last course has been widely adopted in the past; lots of problems never arise if one ignores the topic. The Tennessee law does not require one to teach the accounts of creation given in Genesis and elsewhere. It says only that if you do include the scientific explanations, you have to include the religious ones as well.

Still another response would be to abide by the law and give "commensurate attention to" and "an equal amount of emphasis on" the two conflicting points of view. This is the option I plan to discuss in this paper.

So let us assume that we will carry out the stipulations of the Tennessee law as honestly and as competently as we can. Let us assume also that we do this as teachers of science and not as advocates of some religious doctrine or sect. That is, we will employ *only* the canons of scientific and scholarly procedures in exploring the topic. Statements and hypotheses will be evaluated solely on the basis of the scientific evidence in their favor. Many accounts of creation, including Genesis, are precise enough to be used as working hypotheses from which various deductions can be made. The deductions can be tested, again with scientific data and procedures, and from the results the original hypothesis can be substantiated, made more probable, made less probable, or rejected.

One might object at this point by saying that what I propose to do is not what the Tennessee lawmakers had in mind. That may be, but if I am asked to consider Genesis in a science course, and to treat it as a scientific theory, how else am I expected to do it? Furthermore, as I understand them, this is precisely what the most effective creationists in the country are requesting. I am referring here to members of the Creation Research Society and the Institute for Creation Research. Their campaign in California was for equal time and emphasis to be given to biological education and creationism. Their theory of creation, which is now more often referred to as the "creation model," is derived from Genesis. The basis of their beliefs is given by the credo to which all members of the Creation Research Society ascribe. They "are committed to full belief in the Biblical record of special creation and early history as opposed to evolution, both of the universe and of the earth with its complexity of living forms." They believe, further, "that science should be realigned within the framework of Biblical creationism." More specifically:

> All members of the Society subscribe to the following statement of belief.
> 1. The Bible is the written Word of God, and because it is inspired throughout, all its assertions are historically and scientifically true in all the original autographs. To the student of nature this means that the account of origins in Genesis is a factual presentation of simple historical truths.
> 2. All basic types of living things, including man, were made by direct acts of God during the Creation Week described in Genesis. Whatever biological changes have occurred since Creation Week have accomplished only changes within the original created kinds.
> 3. The great Flood described in Genesis, commonly referred to as the Noachian Flood, was a historic event worldwide in its extent and effect...[1]

It is important to note also that all regular voting members of the Creation Research Society must have an earned postgraduate degree (M.S., Ph.D.

or the equivalent) in science.

Thus, for these influential creationists, at least, we would be complying with the Tennessee law if we concentrated on Genesis as an example of an account of creation. So, for the purposes of this paper, space being a limiting factor, I will suggest how the "equal time and emphasis" for creationism might be devoted to analyzing how adequately Genesis can account for the origin and diversity of living things.

First, it would be necessary to establish what is, in fact, said in Genesis. This is not a simple matter. There is a serious problem concerning what was originally written. Some students may need to be reminded that Genesis has not always existed in the language of the King James Version (KJV). The ultimate source is the ancient beliefs of the Jewish people, which were first written down at various times before the beginning of the Christian Era. The earliest may date to the second millennium B.C., though the oldest surviving Hebrew texts of Genesis are about 1,000 years old. Nevertheless, there is much evidence that the surviving Hebrew texts are highly accurate. That is, when it has been possible to compare the Hebrew Bible with ancient manuscripts, such as the Dead Sea Scrolls, the two are essential identical.

A far more substantial problem is the adequacy of translation. Hebrew was almost a dead language even before the time of Christ. In fact, the sacred texts had become such a mystery that, in the days of Ptolemy II, the Jewish people of Alexandria engaged a group of 70 scholars to translate their sacred texts into Greek. Their product was the Septuagint--dating from the third century B.C. It is the oldest version of the Old Testament. The Septuagint was *the* Bible of the early church in the West and is the Bible of the Eastern church today. Nevertheless, there were many different versions and revisions. The difficulty of knowing what was *the* Word led Origen (A.D. 185-254) to prepare his Hexapla, which survived only in fragments. This consisted of six parallel columns, each with a different version of the sacred texts.

Early in the fifth century A.D., Jerome completed the Vulgate, which was to become the official Bible of the Western church. His was a translation from Hebrew to Latin, using the best Hebrew manuscripts that could be obtained at the time. It is to be noted, however, that he provided not a literal but an idiomatic translation. Jewish scholars continued to work on the problems of choosing the most accurate versions and the most probable readings of the ancient Hebrew words. By the end of the tenth century A.D., they completed what was to become the first official Hebrew text--the Massoretic text.

The Vulgate was translated into English in the fourteenth century by Nicholas of Hereford and John Purvey--their product generally known as the Wycliffe Bible. Early in the sixteenth century Tyndale translated much of the Bible from Hebrew. Various other versions--Coverdale (1535), the Great Bible (1560), the Geneva Bible (1560), and the Bishop's Bible--appeared in the sixteenth century.

What is often regarded as *the* Bible, namely the King James Version, was published in 1611. This was based on the Bishop's Bible, modified by reference to the best currently available Hebrew and Greek texts. Other revisions followed.

The New English Bible (NEB) of 1961 and 1970 will probably be the standard for some years. A. A. Macintosh has this to say about it: "The importance of the N.E.B. as a translation of the Old Testament lies in the fact that it is based upon the most up-to-date scholarship and that it is a *new* translation. This independence has made possible the maximum utilization of the results of modern research. The last century or so has seen a very considerable increase in our knowledge of the languages, customs and institutions of the ancient Near East, as well as of the history of the Old Testament text. The twentieth-century translators of the Old Testament are therefore able to make use of knowledge which was simply not available to their predecessors..." [2]

He goes on to point out that many problems still remain--does an unintelligible word represent an ancient copyist's error, or is it a word for which the meaning is totally lost? Sometimes the problem can be tentatively resolved by reference to other Semitic languages. For example, a word thought to mean only "to know" in Hebrew means both "to know" and "to be tamed" in Arabic, suggesting that Judges 16:9, which is about Samson, should be translated, "And his strength was not tamed," instead of "So his strength was not known," as it has been rendered by previous translators.

Sometimes the new information suggests a wording that modifies the beauty of the King James Version. Take the case of the Twenty-third Psalm, "Yea, though I walk through the valley of the shadow of death." One hearing that statement for the first time might be very confused as to the possible meaning. What is the "shadow" of death? Is the speaker at the point of death? That would be one possibility. Most individuals familiar with the Twenty-third Psalm have no doubt treasured the King James translation for its poetic beauty--and have not worried too much about true meanings. The better understanding of ancient Hebrew, which has come in recent years, suggests that the word translated as "shadow of death" really means "darkest shadow." The modern translation becomes less ambiguous, therefore, even though possibly it becomes less beautiful.

Sometimes the results of biblical scholarship suggest changes that deeply affect church dogma. Consider, for example, the virginity of Mary. Isaiah 7:14, as translated from the Septuagint, and which would have been familiar to the compilers of the New Testament, can be rendered, "Behold a virgin shall conceive and bear a son and shall call his name Immanuel" (KJV). Matthew 1:22-23 refers to this as follows: "Now all this was done, that it might be fulfilled which was spoken of the Lord by the prophet, saying, Behold a virgin shall be with child, and shall bring forth a son, and they shall call his name Emmanuel." However, the official Hebrew Massoretic text speaks not of a virgin but of a young woman. Thus the NEB translates Isaiah as, "A young woman is with child, and she will bear a son, and (you) will call him Immanuel."

One could discuss the evolution of the Bible for a very long time. The amount of scholarship devoted to gaining a better understanding of the Bible is simply enormous. Many science teachers might find this a new and very interesting subject. In any event, they would soon gain the impression that the Bible is something more than the King James Version, and that there still remains great uncertainty in understanding some of the ancient words and statements.

This problem is avoided by many fundamentalists who hold that the translators of the Bible were inspired by God and, therefore, that what they wrote must be correct. If this is so, we are left with the problem that the many different translators, working in many different places and at many different times, were inspired in many different ways. Since some of the different versions give conflicting accounts of the same event or phenomenon, one is left with the problem of which inspiration is correct. This would be a serious problem for the science teacher trying to fulfill the mandates of the Tennessee law. Neither should the teacher sidestep the problem. If the account of creation being discussed is given in the Bible, one has to evaluate the source, just as one is bound to evaluate the data of paleontology, genetics, etc. when dealing with biological evolution.

But let us go on and assume with the members of the Creation Research

Society that "the account of origins in Genesis is a factual presentation of simple historical truths." We will assume, therefore, that the statements in Genesis are working hypotheses, and we will make deductions from the hypotheses and test them.

First, what are the statements? Here many individuals are in for a great surprise. Although the Bible may be the most widely read of all books for all time, few readers seem aware that Genesis has two accounts of creation. So the science class will have to investigate that problem before continuing the analysis.

The first chapter of Genesis plus the first four verses of the second chapter give what is generally considered *the* account of creation:

> On the first day, when the earth was dark, wet, and formless, light was created.
> On the second day the sky (heaven) separated waters above and below.
> On the third day, land and water were separated and plants created.
> On the fourth day, sun, moon, and stars were created.
> On the fifth day, aquatic creatures and flying creatures, the birds, were created.
> On the sixth day, terrestrial forms--mammals, reptiles, and man were created.
> On the seventh day God "ceased from all the work he had set himself to do."

Note the sequence of creation, as far as living creatures are concerned:

> first plants
> then aquatic creatures and birds
> finally reptiles and mammals, including man.

The second account of creation begins with the fifth verse of chapter two of Genesis. The order of creation is not described in days, but there is this sequence:

> We begin with a barren earth totally without plant life.
> Then the Lord God forms Adam from dust.
> Then the Garden of Eden was planted, which contained all the plants.
> Then the Lord God, noting that "It is not good for man to be alone," formed all the wild animals and birds out of dust.
> Finally, none of the wild animals being a satisfactory partner, one of Adam's ribs was removed to form woman.

Some theologians have interpreted the Scriptures as saying that all of this was done instantaneously--not in six days as before.

How is one to interpret these totally different accounts of creation? If we are to regard the statements in Genesis as working hypotheses, we face the problem that the two hypotheses are mutually exclusive. One or the other may be correct, but both cannot be correct. Remember, we are bound by accepted scientific procedures.

Some fundamentalists insist that there is no conflict whatsoever, but it is beyond my comprehension to understand how they arrive at their position. And, in my defense, it can be stated that the fathers of the church regarded this as a nearly insoluble problem. Andrew Dickson White, the famous historian, diplomat, and first president of Cornell, gives a fascinating account of how the early theologians sought to resolve the dilemma [3].

In the minds and words of the fathers of the church, and in the art of the great cathedrals, Genesis was assumed to mean what was literally said. Creation was the *work* of God. This work was more than a moulding of matter; matter was first created, and then it was formed into the earth and its inhabitants and into the celestial bodies. Considerable difficulty arose when an attempt was made to understand the sequence of creation. Most early theologians accepted the first account of creation--in the first chapter of Genesis. Others, however, maintained that the account in the second chapter was more acceptable. Finally, it was agreed that both accounts must be accepted, since the Bible in its entirety was the Word of God. Saint Augustine, among others, maintained and encouraged this point of view. As White describes this problem: "Serious difficulties were found in reconciling these two views, which to the natural mind seem absolutely contradictory; but by ingenious manipulation of texts, by dexterous play upon phrases, and by the abundant use of metaphysics to dissolve away facts, a reconciliation was effected, and men came at least to believe that they believed in a creation of the universe instantaneous and at the same time extending through six days" [3, vol. 1, p.6]. I wonder what would be the effect on a high school student's mind of recounting this bit of history?

Though Augustine and the other fathers of the church could not resolve the dilemma, more recent biblical scholarship can. In fact, the mystery of the two conflicting accounts of creation in Genesis was cleared up during the nineteenth century, a period during which the Bible was subjected to searching analysis.

It was observed, for example, that in the various parts of Genesis there are great differences in style and vocabulary. Sometimes the creator is referred to as Yahweh, at other times as Elohim. This is reflected in the English Bible, where Elohim is translated as God and Yahweh as Lord God. It so happens that the creator mentioned in the first Genesis account is Elohim, or God, whereas in the second account he is Yahweh, or the Lord God. A huge amount of scholarly detective work was done before it was clear, beyond reasonable doubt, that the two accounts of creation included in Genesis had very different origins. In fact, by the 1880's it was established that Genesis and the other books of the Pentateuch represent a compilation of numerous ancient documents. As far as the first two chapters of Genesis are concerned, they are derived from what are called the P and J documents, but, according to *The Interpreter's Bible,* "both of them bear the marks of having been elaborated by writers other than their original authors" [4, vol. 1, p. 465]. The P (for Priestly) document is the youngest. It is thought to have been written after the Jews returned from exile in Babylonia (sixth century B. C.). The Priestly document refers to the creator as Elohim. Its account of creation relies heavily on the Babylonian creation myth, which the priests would have learned about during the exile if it was not already known to them.

The J (for Yahweh) manuscript is much more ancient. It probably was written about the tenth century B.C., presumably after a long period during which the traditions were transmitted orally. This manuscript derives from the beliefs of the southern tribes of Israel, with their fierce god, Yahweh.

This solution to the problem is no longer seriously debated by biblical scholars. There *are* two conflicting accounts of creation in Genesis. One recounts the ancient beliefs of the nomadic tribes of southern Israel; the other unites some of the beliefs of the Jews with Babylonian accounts of creation. The interval between the writing of P and J is roughly the same as between the Dark Ages and today. The fact that numerous conflicting narratives were included in the Pentateuch is interpreted by biblical scholars as an example of political compromise between conflicting groups of priests--of Hebron, Shechem, and Jerusalem. If you can't agree on a single point of view, give all.

Needless to say, this flowering of biblical scholarship in the nineteenth century produced a profound revolution in scriptural interpretation. Whereas biblical scholars from the time of

Augustine to the Enlightenment might make heroic efforts to believe two incompatible accounts of creation, scholars of the nineteenth and twentieth centuries accepted neither as "a factual presentation of simple historical truths." Biblical scholars, Jew and Gentile, Catholic and Protestant, are almost unanimous in placing the first two chapters of Genesis among the creation myths that form parts of the sacred traditions of nearly all primitive peoples. One would, in scholarly honesty, have to present this point of view to one's students.

It is often maintained that biblical statements, such as the accounts of creation given in Genesis, cannot be proven or disproven by scientific procedures. In some sense this is true. If one accepts an initial supernatural phenomenon, there are no restraints on invoking additional supernatural phenomena to explain away difficulties of interpretation. No doubt everyone has heard arguments of the sort that one need not accept the fossil data for evolution at all. It is conceivable, at least in metaphysics, that the earth, complete in its present form (including the fossils), was created 10 minutes ago, etc. But from the time of Francis Bacon, this approach has not proven to be a generally acceptable way of gaining an understanding of the natural world. We and all our works may be an illusion--but it is at least an internally consistent and satisfying illusion to a lot of people.

But we can agree to examine biblical statements as *scientific* statements, as the Tennessee law and its advocates are asking, and to see how they fare. And it must be emphasized again that, in our procedures, we cannot invoke supernatural phenomena to explain away the difficulties. That is, when the time comes to squeeze the creatures of the earth into the ark, we cannot decide to suspend their heterotrophicity or to miniaturize them. A scientific hypothesis must assume an ark with sufficient space for the creatures and for their food, and enough caretakers to control a situation that would make the Augean stables seem like a rose garden.

The key elements in biblical accounts of creation, which will be our hypothesis to be tested, are these: First, the earth and its inhabitants were created in essentially the same form in which we observe them today. We can ignore the differences between an instantaneous creation, suggested by J, and a creation requiring six days, as in P. Well into the nineteenth century, scholars of all sorts assumed that all forms that *could be created were created,* and that all persist today. Ecclesiastes 3:14 was one basis: "I know that whatever God does lasts forever; to add to it or subtract from it is impossible" (NEB). Even so great an authority as Linnaeus maintained this view early in his career [5,p.98]. He believed that all species must have been created in the beginning; if not, this would imply that God's products were defective.

Second, the time of creation was approximately 6,000 years ago. Bishop Ussher usually get credit for having determined this date, but it was generally believed long before his time. The fifth and tenth chapters of Genesis give much of the data. Bishop Ussher was more precise and fixed the beginning of creation at 4004 B.C., and his dates for all biblical events were included in the KJV until quite recently. For many they became part of divine scripture. It was Dr. John Lightfoot, vice-chancellor of Cambridge and one of the most eminent Hebrew scholars of the seventeenth century, who fixed the time of creation more precisely as 9 A.M., October 23, 4004 B.C. [3, vol. 1, p.9].

Both of these elements of the Genesis creation hypothesis suggest deductions. The most obvious one from the hypothesis that life has been the same from the moment of creation to the present is this: If there is a record of past life, then, barring sampling errors, the record should show essentially identical faunas and floras throughout the period for which the record is available. For a test of this deduction one turns to the dates of geology. There *is* a record going back about 3 billion years, but useful for this deduction for only about half a billion years. This record shows that the successive strata of the earth's crust contain different assemblages of organisms--the differences increasing with the distances between the strata.

With respect to the Genesis hypothesis of a young earth, we can make this deduction: If there are scientific methods for determining age, natural objects must be younger than, roughly, 6,000 years. Again we can turn to the physical sciences, where we find that various methods of determining age are available. These are of varying accuracy, all lacking the precision of Dr. Lightfoot's, but they do demonstrate that, beyond a reasonable doubt, the earth is extraordinarily old.

These two hypotheses, which can be tested readily by accepted scientific procedures, show that beyond a reasonable doubt the accounts of creation given in Genesis cannot be scientifically true. They may be of extraordinary religious, emotional, metaphysical, metaphorical, or literary importance, but they are not useful working hypotheses for science.

A point of even greater importance is that a science teacher would have to explain to the students why hypotheses based on the accounts of creation given in Genesis, or from other religious traditions, can *never* be useful in science. Natural phenomena are to be explained by a scientist only in terms of phenomena that he can observe and study. Supernatural explanations are not permitted. Thus science must ignore hypotheses that involve the creation of matter and energy ex nihilo. Thus, there are valid scientific and procedural grounds for rejecting the hypotheses of creation based on Genesis.

Yet there are many other statements in Genesis about events after creation that apparently involve no supernatural elements, and hence may be treated as hypotheses to be tested by scientific procedures. A few of these will be mentioned to illustrate how they might be developed in a classroom.

The problem of the continuity of human beings is a serious one if the biblical statements are to be taken literally. Only two human beings were created--one male and one female. Their first two children were males (Cain and Abel). Subsequently there were other males (Enoch and Seth). Very much later other males and females were produced by Adam and Eve. However, the first members of the F_1 generation consisted only of males. Current biological theory suggests that there could have been no F_2. Yet, according to Genesis, F_2 were produced in abundance.

Following the creation, the flood was by far the most important event for living creatures. The account given in the sixth through ninth chapters of Genesis is a combination of both J and P manuscripts--which accounts for the contradictory statements. Both seem to be based on the Babylonian story of the flood given in the Gilgamesh Epic. The essential points of the Genesis account are these:

1. Every living thing perished. As Genesis 7:23 gives it, "God wiped out every living thing that existed on earth," except for those on the ark.
2. The waters covered the entire earth reaching a height of 15 cubits (a cubit is the distance from the elbow to the end of the middle finger), or about 7 meters above the highest mountains.
3. The flood was due to rain water according to J, and to rainwater plus subterranean water according to P.
4. The duration of the flood was 40 days according to J and 150 according to P. J and P also differ on the time before the waters dried up, but, in any event, they did.

Thus, all life subsequent to the flood was descended from the animals and plants that Noah had taken into the ark. The ark, therefore, becomes a bottleneck, and numerous biological questions can be asked about it: how was it filled, and what was the history of the organisms once they were released from the ark, etc? Once again, these matters must be dealt with in a scientific manner--that is, we cannot invoke supernatural phenomena to explain difficulties that may arise. A host of problems present themselves. Some of the more obvious ones are (of course these are not new questions--they sorely beset theologians of earlier times):

1. What was the mechanism that caused the animals to migrate from their homelands to the Near East? Did the giant earthworms of Australia have a premonition of the flood and a nervous system complex enough for them to take the necessary precautionary steps?
2. By what route did all the animals, especially those with very limited means of dispersal, get to the Middle East to board the ark? This would seem to have been especially difficult for all organisms of the New World and essentially impossible for those in Australia (and all remote islands).
3. How did Noah obtain plants or their seeds from areas distant from the site of the construction of the ark?
4. What so modified the patterns of behavior of the animals that they were able to exist together for the duration of the voyage?
5. How could the roughly 2,000,000 species of organism known to inhabit the earth, including terrestrial, fresh-water, and marine forms, plus food to last for about a year, be domiciled in an ark which we are told was about 150 meters long, 25 meters wide, and 15 meters high?
6. If, as Genesis says, all living things not in the ark were destroyed, how could the dove sent out in search of dry land return with a freshly plucked olive leaf?
7. When the ordeal was finally over and the ark door opened, how did the organisms reach the localities where we now find them? They would have the same problems as they did in coming to the ark, except for an additional major disadvantage: the flood has sterilized the earth of all living creatures. What would have served as food for the animals?

One could continue this sort of scientific exegesis and hermeneutics, but more than likely enough has been given to allow us to reach some obvious, though important, conclusions.

The first is that, if one is to subject Genesis to the sort of analysis that the law of Tennessee and some of the more prominent creationists are demanding, the Genesis account is demolished from a scientific point of view.

The second point is that if one gets out on the fundamentalist's limb of maintaining that *all* biblical statements must be true, and one demonstrates that part cannot be scientifically true, then the entire opus becomes questionable.

I believe that these are the inevitable conclusions that a science teacher and his students must reach if they stick to an entirely scientific analysis of biblical statements. Either the Bible is wrong or science is wrong, and very few educated persons in the modern world maintain the latter.

Is this what the lawmakers and the creationists desire? I doubt it. Yet, unless one makes the improbable assumption that they seek to hold religion up to ridicule or to destroy it, I cannot imagine that they truly desire a critical and scientific evaluation of Genesis. During the past century biblical scholars and scientists have independently reached the same conclusion: the ancient Hebrew accounts of creation, as recorded in Genesis, cannot be accepted as "a factual presentation of simple historical truths."

Those ancient Hebrews left a rich legacy to the world--but this legacy was singularly lacking in scientific accomplishments. One looks in vain for a single Hebrew scientist in the long ages down to the Roman destruction of Jerusalem (A.D. 70). I do not know of a single scientific discovery that is credited to the ancient Hebrews. Seemingly they put little store in such matters, for how else is one to explain the inclusion in Genesis of that part of the creation myth that has light created before there was a sun, or that the race was continued only by males, or any of the other numerous notions that must have been obviously false to the Hebrews by the time they finally began to assemble the Bible. It makes far more sense to me to believe that these ancient scholars simply were not enough interested in natural or scientific matters to think it necessary to expunge their ancient traditions of obvious errors. No one today, at a time when genetics has reached such glorious heights, is upset if we speak of "our blood relations." Somehow that sounds more comfortable than "sharing the same genetic code."

I think that the most probable explanation of the creationists' demands is that neither they nor the Tennessee lawmakers have thought out the consequences of those demands. Had they done so, surely they would not wish science teachers to deal with these questions. To give "equal time and emphasis" to creation myths and to the biological theory of evolution must lead to the destruction of the former.

Quite possibly the creationists would say that I have not developed the topic along the lines that they wish. No doubt this is so. Their main activity for the past century has been to advance the creationist point of view, not by developing a creationist hypothesis, but by attacking the biological theory. Somehow they seem to work on the supposition that there are only two explanations, and that if you can cast sufficient doubt on one, the other is thereby established as true. There were uncertainties in Darwinian theory in 1859, and there are uncertainities today. Nevertheless, there has been a steady progress in understanding what all, with even a partially open mind, must admit. Creationism, on the other hand, has become ever more bankrupt as an explanatory hypothesis. More than a century ago Herbert Spencer remarked: "Those who cavalierly reject the theory of evolution as not adequately supported by facts seem to forget that their own theory is supported by no facts at all. Like the majority of men who are born to a given belief, they demand the most rigorous proof of any adverse belief, but assume that their own needs none" (quoted in [6,p.154]).

But we must remember that creationists have a strange relationship with what everyone else regards as facts. I have recently surveyed the creationists' arguments of a century ago and compared them to the present time. For the most part the same objections are being raised now as then to the biological theory of evolution. Seemingly the discoveries in the biological and physical sciences of the past century have made no impression. Each discovery of new evidence of the age of the earth, of fossil remains that give improved understanding of lineages, and of experiments dealing with the components of the evolutionary process is ignored or rejected. Seemingly there is no amount of data that will convince a creationist if he does not wish to be convinced. Not infrequently they behave as though they were adhering to the advice of Robert Owen--"Never argue: repeat your assertion" (quoted in [7]).

But, to a very limited extent, the creationists do more than argue. Recently the *New York Times* reported that the Institute for Creation Research is mounting an expedition to Mount Ararat to search for remnants of Noah's ark (report published in [8]). Previous attempts to secure the approval of the Turkish government had been unsuccessful, but now, hopefully, permission will be granted. The eight-man expedition is to be led by the son of the director of the Institute for Creation Research. The plan is to search for the remains of the art near the 14,500 foot level of the mountain. I should like to offer a helpful suggestion: even the most elementary computations will show that, if the ark did what Genesis demands, it must have been so huge that Mount Ararat could easily rest on it, rather than it on Mount Ararat. Thus, I suggest that the expedition should look, not at the 14,500 foot level, but underneath the mountain.

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“Scientific Creationism”—A New Inquisition Brewing?

Preston Cloud

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In this wide-ranging article the author discusses the creationist movement, looks at the strict rules under which science must operate, investigates the question of origins, and presents some observations on particular creationist claims. The author is a research biogeologist with the U.S. Geological Survey and professor emeritus of biogeology and environmental science at the University of California, Santa Barbara.

THE CREATIONIST MOVEMENT

Religious bigotry is abroad again in the land. And, in addition to socialism, sex education, and birth control, it is tilting anew at an old bete noire --evolution. Within the larger fundamentalist movement, a small group of hard-core zealots, comprising the membership of the Creation Research Society (CRS), is riding a crest of supernaturalist fervor to battle against a basic liberating tenet of civilized peoples--the separation of church and state. The five hundred or so members and many supporters of this organization, who call themselves creationists, see the ancient Judeo-Christian creation myths of the first two chapters of Genesis as constituting a single, divinely revealed account of origins that must be restored to preeminence in public-school teaching. Toward this end, they insist, the biblical version(s) of creation must be given "equal time" with scientific accounts of the progressive development of life from simple to complex forms. It does not satisfy them that biblical creationism receives equal time with other religious accounts of origins in courses in comparative theology. They demand that creationism be presented as a "scientific" alternative to evolution in science textbooks that deal with the origin and subsequent development of life before such textbooks can be approved for use in the public schools. They have even prepared their own textbook to serve this end, *Biology: A Search for Order in Complexity*. The outlooks described are those encompassed under the terms *creationist* and *creationism* as used in the present paper.

The humanistic preference for rational thought, particularly as seen in the search for naturalistic explanations of natural phenomena, has, of course, always been unpopular among those who prefer the supernatural, whether it be benign, diabolical, or simply whimsical. But why this strong resurgence of the age-old struggle between naturalistic and mystic perceptions of the universe? How do the creationists arrive at and support their proposition?

A part of the credo to which all members of the CRS subscribe is that "all basic types of living things, including man, were made by direct creative acts of God during the creation week described in Genesis." Elaborating on this, their leading polemicist, H. M. Morris, emphasizes in his book *The Remarkable Birth of Planet Earth* (1972) that "*it is only in the Bible that we can possibly obtain any information about the methods of creation, the order of creation, the duration of creation, or any of the other details of creation.*" The Bible claimed to be not only inspired, but factual, thus is seen as a scientific document, moreover, that, coming from a supposedly infallible source, is not open to inquiry or interpretation. Scholarly documentation of pre-Hebraic antecedents, including the two different versions of creation given in the first two chapters of Genesis, is ignored or brushed aside, and the "days" and other terms of the King James version of the Bible are taken literally as written--"*If it really took five billion years for God to make all these things, why did He tell us it took six days?*" asks Morris.

Incredible as it may seem, such a rationale is held to comprise a "creation model," scientifically comparable to the greatly refined modern version of the theory of evolution by means of natural selection. This position is reinforced, in the creationist view, by adding that "evolutionism," like humanism, is itself a form of faith or religion anyhow. According to such an argument, it is then seen as only fair that the "creation model" be taught on an equal footing with the "evolution model." Apparently, the creationists either believe that rational judgment, in this instance, can and should be suspended, or it has not occurred to them that a balanced and critical consideration of the alternatives and their supporting sources is bound to bring out the "heathen" antecedents and internal inconsistencies of the Genesis account, its exclusive reliance on revelation for support, its predictive barrenness, and its total refutation by two centuries of geological and biological investigation and the refined measurements of modern geochronology.

Although the creationists may be irrational, they are not to be dismissed as a lunatic fringe that can best be treated by being ignored. In California, which accounts for about 10 percent of the public school enrollment and thus exerts great leverage on textbook publishers, they have proven themselves to be skillful tacticians, good organizers, and uncompromising adversaries. As J. A. Moore has shown in his account of the California controversy, creationists were able to gain control of the State Board of Education from about 1963 to at least 1974, and, during the same time, to get an adherent to their views elected as Superintendent of Public Instruction until 1970. This board then proceeded to revise the *Science Framework for California Public Schools*, prepared by the California State Advisory Committee on Science Education, in such a way as to distort the findings of the scientists on that committee and introduce a creationist bias: a situation that led to tough negotiation and uneasy compromise.

The position of scholarly theologians and a substantial majority of literate, practicing Christians regarding the creationism of CRS is well expressed by statements quoted by Moore of the Very Reverend C. Julian Bartlett, dean of Grace Cathedral in San Francisco, and Dr. Conrad Bonifazi, professor of philosophy and religion at the Pacific School of Religion in Berkeley. Bonifazi summarizes: "Broadly speaking, then, the situation is thus: an extremely conservative wing of Christian sectarianism, which has little or no repute in the world of theological scholarship, adheres to a literal interpretation of the Bible, and is therefore committed to saying that evolution contradicts the biblical account of creation. Its belief in the 'infallibility' of the Bible does not even permit it to recognize that in Genesis itself there are two accounts of creation, each differing from the other in background and in content. It is also true that the major *denominations* of Protestantism and the Roman Catholic Church in the United States recognize and condone the teaching of evolution in the disciplines of natural science. These denominations represent a large majority of Christians in this country." And Reverend Bartlett adds: "That Biblical myth-story was but one of many such which were developed by primitive religions...it is a religious and therefore theological document and not a scientific treatise."

If the creationists are deterred by such comments from these and other religious scholars and scholarly theologians, whose judgment one might think they would respect, there is no sign of it. As Moore has observed, and with good reason: "Scientists who have dealt with fundamentalists simply do not trust them; they rather imagine that, if the fundamentalists had the power, they would happily reinstitute an inquisition." And anyone who has studied their benign manner in public debate, their tortured logic and their often scurrilous expression in books and tracts for the faithful, has little difficulty in visualizing creationist polemicists, given the opportunity, in the role of Pius V himself. Examples of creationist logic and tactics may be found in their cartoon strip "Big Daddy," in Morris's equation of evolutionism with racism and Hitlerism, in remarks about the dishonesty of geochronologists by Slusher in his "Critique of Radiometric Dating" (ICR Technical Monograph No. 2, 1973), and in many other places in these and other tracts obtainable from the Institute for Creation Research. Their "give 'em hell" approach is meeting much success in California and other areas with large fundamentalist followings.

Yet scientists have been negligent both in rising to the defense of rationalism against the creationist attack and in explaining briefly and clearly the available evidence for evolution. It is not enough to shrink from the creationist position; it must be exposed. It is not enough to state that evolution has occurred; at least a sense of the nature of the evidence involved must be transmitted. At risk of belaboring the obvious, therefore, I will briefly summarize the scientific and the creationist positions. Then, in the space remaining, I will attempt to deal with one and to explicate the other insofar as the bearing of fossils and rock-ages on the question of origins is concerned. Those seeking more extended discourse, but not wanting to go deeply into scientific treatises or even textbooks, will find it in two brief and readable articles by N.D. Newell (*Proceedings of the American Philosophical Society*, 1973; *Natural History*, 1974), and in longer, but equally readable, books by G. G. Simpson (*This View of Life--The World of an Evolutionist*, 1964) and W. S. Beck (*Modern Science and the Nature of Life*, 1957), among others.

THE APPROACH TO SCIENCE AND TO CREATIONISM

In trying to arrive at a balanced judgment of issues involved, the nature and methods of both science and creationism need to be understood. Science can be described as a special, *active* way of trying to understand the universe, solar system, and earth. It differs from subjects such as fundamentalist theology that seek their insights wholly from inspiration, meditation, intuition, or divine revelation, unhampered by experimental or naturalistic constraints. Inspiration, meditation, and intuition also play important parts in the mental processes of scientists, but ideas so arrived at do not become a part of science until checked against relevant evidence and found to be consistent with it.

Evidence relevant to science consists

of measurements or observations that can be made or confirmed by human observers. If the evidence is experimental, the experiment must be repeatable by others, with the same results. Should the evidence be the results of natural processes, such as floods, earthquakes, climatic change, or exploding stars, the observations must be repeatable. Others observing the same results must be able to see and measure the same thing.

The rules under which science operates specify that scientists must strive for objectivity. That objectivity is difficult is a part of being human. Even the most self-disciplined are products of previous experience and social climate. Although *total* detachment is impossible, the work of the scientist is under constant scrutiny by other scientists and that promotes caution. Characteristically, the ability to do first-rate science is not fulfilled by a high level of intelligence alone. Intellectual, as well as personal integrity, balanced and critical judgment, and independence from authority in affairs of the mind are also important. Unverifiable assumptions are not permitted. Assumptions made must be consistent with what is already known, and they must be clearly stated so that others can see, test, and challenge them.

The central assumptions of science are that there is order in the universe and that this order can be found and explained. Its twin goals are thus: (1) to search for order in the universe, and (2) when found, to attempt to explain it in terms of processes that can be detected and measured or in terms of processes whose results can be observed and shown to be consistent with causes that do not violate the facts or laws of nature. Science may not invoke supernatural causes--not even in support of divine revelation. There can be no intellectual conflict between science and theology because they are mutually exclusive realms of thought. That involves no value judgment at all. Supernaturalism is not science, and science is not supernaturalism. It is that simple.

The approach to theory in the *scientific* sense starts, not in books, but with *data* and the formulation of *hypotheses* (or a group of related hypotheses called a model). A hypothesis is an attempt to explain the observed data. Science requires that its hypotheses be consistent with known evidence from experimentation or nature and that they have *verifiable consequences* -- that is, they must be capable of disproof. One way of increasing objectivity is to think of as many hypotheses as possible that are consistent with the evidence and have verifiable consequences. As competing hypotheses are tested, their believability grows or shrinks as they withstand or fail opportunities for disproof. From at first being simply permissible, they either are eliminated or grow in believability until the most successful hypothesis may become a *ruling hypothesis*. If such a ruling hypothesis continues to be successful in predicting previously unsuspected facts or relationships, and withstands all opportunities for disproof, and if it has broad application, it may finally be accepted as a *theory*, often modified from the original hypothesis. These distinctions are important. Although not always made, they should be. They express different levels of probability, which is what science is all about.

It is essential in science to distinguish among observations and measurements, the hypotheses and theories that integrate and propose *mechanisms* to explain the facts observed, scientific principles that specify operating procedures, and the *laws* of science. The laws of science represent the highest level of supportable generalization. In order to be accepted as a law, the generalization must have proved invariable under all of many observed circumstances; or if variations are observed, they must occur in systematic and predictable ways. The laws of science may not be broken.

Angular momentum must be conserved. The entropy of a closed system may not be decreased. Water may not flow uphill without a pump. Hypotheses that run against established scientific law are not acceptable unless they can demonstrate that the law is wrong.

It is characteristic of science that it is controversial. Scientists love to explore new areas, methods, and ideas. Hypotheses, and even theories that once appeared well established, may be challenged, modified, and even overthrown as they are tested against new experimental or observational data or better measurements. As investigation continues, the explanations of science sort out at different levels of probability without ever being considered unchallengeable where new evidence suggests the possibility of other naturalistic causes. Science is thus dynamic, progressive, ever changing, never finished. It is like the expanding wave-front of a pebble flung into a sea of ignorance; its growth both widens the domain of scientific understanding and expands the surrounding circle of ignorance as new knowledge raises new questions. Moreover, previous knowledge, without necessarily being wrong, constantly needs reconsideration in the face of new knowledge or new scientific ways of looking at it. As science expands into space, Euclidean geometry yields to hyperbolic geometry and Newtonian gravity is refined by relativistic gravity. Darwinian ideas of selection evolve into more complex theory as we prove the molecule, behavioral responses, and the rocks. The stable continents of a few decades ago become moving pieces in a great new game of geologic chess because of discoveries made on the ocean floor.

Creationism, on the contrary, is seen by its adherents as fixed, immutable, divinely revealed truth--unchanged and unchanging since the writing of the original Hebrew text, or perhaps the older but similar Babylonian and Sumerian accounts. No less an authority than H. M. Morris himself, the director of the Institute for Creation Research, assures us that "the Genesis record of creation was verified by God himself as He gave the ten commandments." Never mind the glaring discrepancies between Genesis and the evolutionary sequences of geology, of which Morris finds "at least twenty-five"--grass, herbs, and trees before the sun, for instance. To creationists, this simply demonstrates that such vegetation must have grown in the light of the divine presence itself.

In their many public debates, creationists employ a fivefold strategy: (1) Get out the vote by means of advance agents that arouse local fundamentalist groups in order to assure a strong claque of supporters in the audience. (2) Attack evolution on the grounds that, as is usual in science, some details of the sequence and mechanisms involved are not agreed upon. (3) Snow the unsophisticated with claims that evolution violates the most misunderstood of scientific generalizations, the second law of thermodynamics. (4) Deny the evidence for intermediate forms and their gradual appearance over geologically long spans of time, introducing whatever wild claims or denials appear best suited to that purpose. (5) Claim that a literal interpretation of the Bible provides the only foundation for morality in a wicked and changing age. Granted, then, that there is disagreement among evolutionists, however trivial that may be, and that the second law of thermodynamics and alleged lack of intermediate forms are seen by them as verifiable consequences of creationism, but contradictory to evolution, Genesis emerges in the eyes of the creationists as the only alternative, without need for documentation or discussion beyond the simple assertion that it is the word of God.

It is an appealing scenario to those enamored of simple, unwavering answers, but much too successful at winning over the uncritical popular mind to be brushed aside or underrated by scientists and other humanists who see reason as the quality that offers the best hope for mankind's eventual liberation from the tyranny of fear, superstition, suspicion, and hostility.

THE QUESTION OF ORIGINS

To turn now to the question of origins, creationists focus on the origin of the earth, of life, and of the diversity of life. However, since the findings of nuclear science and astrophysics on the origin of the chemical elements tell us that the stars preceded planetary formation, and that not even the chemical elements have always existed, I will start with the origin of the universe. Given a ball of neutrons at the beginning, scientists can think of naturalistic explanations of varying degrees of probability and testability for all subsequent events. There is, however, no scientific explanation for where the primordial ball of neutrons might have come from. In fact, there is no certainty that there was only one and not several balls of neutrons, or even that the universe didn't emerge from one or several black holes, or from a deity. And, of course, we have no idea what such a deity may have been like, or from where it (or She or He) may have come. *That* is the problem of *first* causes. Science has no answers to the problem of *first* causes, although it can place limits on what kinds of answers are permissible. Science does not contradict the idea of a divine origin for the embryonic universe, during which it acquired those characteristics we designate as natural laws, whose unfolding underlies all later events. It does, however, have something to say about the permissible time framework and the composition of primordial materials. It also has a lot to say about those later happenings--the ones with which the creationists occupy themselves.

Evolution implies a systematic progression of related events--a continuous or stepwise process of change from one state to another. It is hard to think of systems that do not evolve --social, political, economic or natural. Even though they may equilibrate temporarily, change sets in sooner or later. Historical geology attempts to trace the interrelated evolutions of life, air, water, and earth's rocky crust. Its results leave *no doubt that change from simple, slightly diversified to complex and greatly diversified forms of life has taken place over billions of years of geologic time.* In charging evolutionists with dogmatism, creationists both deny that fact and confuse it with the mechanism by which changes were achieved.

That mechanism is always open to debate. Competing hypotheses have repeatedly failed to displace Charles Darwin's basic concept of progressive change brought about by selective processes acting on naturally varying systems over long periods of time in response to changing circumstances. Indeed, creationists are clever enough not to deny either natural variation or the effects of selective processes on local populations. What they do deny is time in excess of a few thousand years and the reality of the progressive changes observed. Instead, all the "basic kinds" of life are seen by them as having originated in a complete state of "perfection" during the third, fifth, and sixth days of creation, after which, giving vent to some unexplained whimsy, God decreed the second law of thermodynamics, whereby free energy decreases, order decreases, and the universe retrogresses from its initial state of perfection forever after. Things are getting worse all the time, 'tis said, and they will get still worse for those who fail to accept the gospel of H. M. Morris, D. T. Gish, (*Evolution: The Fossils Say No!*, 1973), H. S. Slusher, J. C. Whitcomb, Jr. (*The Early Earth*, 1972), and others.

In contrast to the creationist approach, the scientific way to assess evolutionary theory is to ask what it predicts, or "postdicts," about the past, about the geologic record of life. *Current* evolutionary theory, of course, is more complex than that visualized by Darwin, including a foundation of experimental evidence unknown to him, and it is still evolving. It does, however, predict the following: (1) Life either originated on earth under an essentially oxygen-free atmosphere not long after liquid water first began to accumulate or it reached here from elsewhere in the universe. (2) The earliest forms of life were very simple cells without well-defined nuclei, which evolved in essentially oxygen-free environments until such time as their photosynthetic activities and tolerances to oxygen permitted that gas to accumulate in the atmosphere. (3) More complex, truly nucleated, and, eventually, fully sexual microorganisms evolved only after atmospheric oxygen increased to levels capable of supporting a fully oxidative metabolism. (4) Many-celled animals came later, the first of these being delicate, soft-bodied, thin-bodied forms because they depended on simple diffusion for their oxygen supply. (5) Multicellular animals acquired protective armor or external skeletons only later, as oxygen levels increased and internal oxygen-transport systems evolved. (6) There has been a general although by no means regular, steady progression of increasing variety and complexity of life from that time until the present.

How do these predictions fit the geologic record? Not only have they been borned out by the steady growth of factual evidence, but nuclear age determinations confirm and amplify the observed sequences of geology. Such nuclear methods permit estimates in atomic years, equivalent to *present* sidereal or clock years, for about how long ago major changes occurred. Consider the predictions (postdictions) above in the order presented. (1) During the past 15 years we have learned that life and the beginnings of photosynthesis originated more than 2 billion years ago and probably more than 3.8 billion years ago. A substantial body of evidence has also accumulated in support of the chemical probability of steps leading toward the origin of life by chemical evolution from nonliving antecedents under oxygen-free conditions; that evidence, however, derives from chemically sophisticated laboratory experiments and cosmochemistry that will not be dealt with further here. (2) The oldest demonstrable organisms were very simple single-celled and filamentous forms, and the geochemical evidence indicates an absence or very low level of oxygen in the atmosphere at the time. Although some of these organisms probably were photosynthetic, oxygen did not accumulate because released oxygen was absorbed in vast sinks of reduced substances, including dissolved iron that formed our largest iron deposits during an episode of iron formation that has not been repeated on the scale earlier observed for the past 2 billion years. (3) Free oxygen first began to accumulate in the atmosphere about 2 billion years ago, as shown by the oldest records of oxidized sediments deposited on the continents of the time, while the oldest cells of a truly advanced nature so far known are younger--about 1.3 billion years old. (4) Many-celled animals are first known from rocks about 680 million years old; these delicate, soft-bodied, thin-bodied or thin-walled animals of primitive sorts are related to worms, jellyfish, and sea pens, but without shells or skeletons. (5) The first shell-bearing animals appeared about 600 million years ago; they were very simple types --trilobites and most of the main kinds of organisms did not appear until later. (6) Although early multicellular diversification was rapid, a natural consequence of the many, then unoccupied, ecologic niches and probably multiple origins, the progression was orderly. From then until now there has been an essentially continuous progression of increasing variety and complexity of multicellular animal life.

I have written above of my own field of specialization. The results I have summarized so briefly come from forty years of independent study and research on life processes in earth history.

Let me now add some words about the discontinuities in the evolutionary record, of which creationists make so much. Populations of forms, transitional from one successful form of life to another, should be small, peripheral to larger populations of successful forms, and represent brief time spans. Only evolutionary successes become abundant enough to have a good statistical chance of leaving a fossil record, and those numerous forms that lack hard shells or skeletons are only rarely preserved. Because land deposits tend to be weathered and eroded, while marine ones tend to be preserved, marine fossils are more common than those of land animals; and on the continents, smart animals like man rarely become fossils by accident. Nevertheless, there *are* intermediate forms, as well as gaps; and although no person was there to witness the progress of evolution in prehuman times, its results are in the rocks for all to see. Just as we do not discard Newtonian or Einsteinian gravity because we do not have measurements of the mutual attractions between every particle in the universe, so the general evolutionary progression is clear, even though fossil remains are not found for every creature that ever lived--and even though more than a few new forms appear abruptly in the geologic record either because of its incompleteness or as a result of processes not yet well understood.

Evolution as a historical phenomenon rests on as sound and extensive a factual basis as any scientific generalization we know.

The mechanism of evolution, as noted earlier, is a different matter. Although no one since 1859 has come up with a durable scientific alternative to the action of natural selection on varying populations or gene pools, the possibility of large jumps as a result of precocious sexual maturity or for other reasons is still debated, while the evolution of nonsexual organisms involves different patterns from that of sexual ones. The rules of science require that, if situations should be found in which natural selection is not consistent with the facts, it must be modified or abandoned. This doesn't mean, however, that it needs to be seriously reconsidered *without* the introduction of *new* evidence because a few people don't or won't understand it. Thus, among biological and biogeological scientists, natural selection in the modern sense, sometimes called "the synthetic theory of evolution," is the favored theory for the observation that organisms *have* evolved.

If evolution over a long time interval, as documented by the geologic record, is to be explained as the work of a deity, that also has some consequences, although not verifiable. The deity either set the rules by which evolution took place or personally created all of the millions of species that have ever lived, and in a generally systematic progression of increasing complexity and diversity.

Two last thoughts before turning to a consideration of particular creationist arguments against evolution. Creationists fear that without a literal acceptance of the Bible, there is no basis for morality. In contrast, it seems to me that the best testament to the basic goodness of mankind is that so many are honest and compassionate for reasons other than fear of punishment or religious conviction.

Then there is the matter of one's vision of divine cause. If one holds to the view of a supreme being, is it more elevating to think of that being as a grand architect who set the whole thing in motion with a divine plan of operation and then let it alone, or to think of her or him as the whimsical builder pictured by a literal interpretation of Genesis?

SOME OBSERVATIONS ON PARTICULAR CREATIONIST CLAIMS

Why, then, do creationists cling to

an internally inconsistent six-day miracle where "creation science" is a contradiction in terms and even the word *creationism* has a different meaning to biblical scholars? On what grounds does the CRS attack evolution? Six of their central substantive arguments are briefly considered below.

1. *Creationists claim that intermediate or transitional forms predicted by evolution theory are not found in the fossil record.* I have already explained some of the reasons deficiencies in the fossil record are to be expected and, in fact, common. But real intermediate forms are *not* lacking. The creationists are aware of this but choose to deny the evidence. Consider four examples. (a) In the case of *Archaeopteryx,* intermediate between reptiles and birds, creationist D. T. Gish insists that, since it had wings, feathers, and flew, it was clearly a bird and nothing else. It is, of course, true that among living animals, feathers are found only among birds. Contemporary with *Archaeopteryx,* however, were good reptiles that also had wings and flew. *Archaeopteryx* also had teeth, which occur in no living birds. Indeed, Yale paleontologist J. H. Ostrom, who has restudied in detail all of the few known specimens of *Archaeopteryx* reported in the British journal *Nature* in 1973 that, were it not for the associated impressions of feathers, he would have identified these specimens unequivocally as small theropod dinosaurs with birdlike pelvises. Because it had characteristics of both reptiles and birds, therefore, *Archaeopteryx* is intermediate by definition. But our ways of classifying animals do not provide for intermediate forms. We must choose between reptile and bird or invent a new class with some features of each. As a matter of simplicity and priority, *Archaeopteryx* is classified as a bird. (b) *Ichthyostega,* a 350 million-year-old creature, also denied as transitional by creationists, has the skeleton of and is regarded as a very fishlike amphibian, yet it might equally well be considered a very amphibianlike fish. (c) As for amphibians and reptiles, the differences are so gradational that one might say that the first amphibian to lay an egg that could survive desiccation and hatch out of water (an amniotic egg) was a reptile. (d) Intermediates between reptiles and mammals are so numerous that, although current opinion favors a single main line of evolution from reptile to mammal, there could have been several ancestral reptilian lines, all evolving mammalian characteristics at the same time. The classification of intermediate forms is, in fact, a major procedural problem in modern paleontology. I do not, of course, assert that there are no gaps. They appear to exist, and they are puzzling; but if evolutionary science is to progress toward a better understanding of them, this will not be achieved by using the creationist broom to sweep the problem under the rug.

2. In the creationist scientist-joke cartoon strip "Have you been brainwashed?" D. T. Gish states that *"billions of highly complex animals-trilobites, brachiopods, corals, worms, jellyfish, etc. -- just suddenly appear in the geological record at the base of the Cambrian."* He can be forgiven for this mis-statement because part of it could be derived from careless reading of source materials, including my own writings. But it is *not* true. Since 1954, a variety of primitive microorganisms have been found to occur through a long sequence of rocks dating back to more than 2 billion years ago. We now also have evidence that a limited variety of multicellular animal life began about 680 million years ago, perhaps 80 million years before shell fossils of the Cambrian, and that higher forms appeared sequentially up to, through, and beyond the Cambrian. Also contrary to Gish, corals were never thought by people familiar with the evidence to exist in earliest Cambrian time. Moreover, all of the forms mentioned are still simple forms of life compared with those that came in *successive* waves of greater complexity

and diversity over the succeeding half billion years of geologic time. The contrast with the creationist fantasy of a six-day creation week could not be greater.

3. *Creationists assert that time has been too short for evolution.* Geochronologists and cosmochronologists, they say, are mistaken about the great age of the universe, the solar system, and the earth. Slusher's "Critique of Radiometric Dating" attacks geochronologists for "apparent intellectual dishonesty." He states: *"Most creationists.... have viewed the evidence regarding the age of the earth as pointing to a very young age of from about 7,000 years to 10,000 years."* All the elegant and internally consistent work of a host of geochronologists the world over, using a variety of sophisticated instrumentation and self-checking systems for the last quarter century, is rejected because it does not fit Genesis. One half-baked calculation by a creationist of the time required for decay of the earth's magnetic field (Slusher, 1973) gives an age that approaches the creationist preconception! *That* age is spurious because the assumptions are invalid. Earth's magnetic field, to be sure, does decay, and on a cycle of thousands of years; but it is constantly being renewed by motions in the earth's liquid core. I add only that the devoutly Christian E. A. Milne, in his 1952 deathbed treatise on "Modern Cosmology and the Christain Idea of God," found no problem with a great age for the earth or the universe. Indeed, he thought that classical clock time, based on inconstant relations, was slowing down relative to constant atomic time, so that the age of the earth in conventional clock years was probably vastly greater than its atomic age, now estimated at 4.6 to 4.7 billion years.

4. *Creationists insist that all fossils were actually deposited at the time of the Great Noachian Flood* of about one year's duration. Apart from the problem this makes with the sequence of rocks and with geochronology is that of the volume of sediments needed to fall from suspension in a bit over a year. We know continuous sequences of stratified rock as much as 20 kilometers (12 miles) thick; and if all those known in time sequence were piled in the order of their deposition, they would be many hundreds of kilometers high. A modern reservoir, say 60 meters deep, made by damming a river in a rapidly eroding area, takes about 100 years to fill with sediment, even allowing for catastrophic floods. At that rate, it would take about 32,000 years for 20 kilometers of stratified sediment to accumulate, and remember that I speak of muddy river water, wet sediment (that would compact to much smaller thickness when dry), and a small reservoir. If one multiplies 32,000 by the hundreds, the years become millions, underscoring the difficulty of accounting for even a small fraction of the sedimentary rocks known by the deposits of one year's time. Indeed, the method of sedimentary rates used by early geologists to estimate the age of the earth gave numbers of around 100 to 400 million years. This, however, included little of pre-Cambrian history and left out erosion and nondeposition. We now find much longer ages, using precise, self-checking nuclear methods. I should add here, however, that the legend of a great lowland flood some thousands of years ago *is* widespread and that Cesare Emiliani, of the University of Miami, and others, in a paper in the American journal *Science,* in 1975, have suggested that such a flood may well have happened as a result of a rapid advance and melting of a very late Pleistocene ice sheet about 11,600 years ago--precisely as reported from early accounts by Pliny the Elder.

5. Similar to their claim that all fossils were formed at once during the biblical flood, creationists *assert that the use of fossils as age indicators is self-fulfilling* because when paleontologists find particular fossils they claim the assigned age. Here I

would ask you to visualize the Grand Canyon, along whose walls is a succession of nearly horizontal, layered rocks that can be traced with the eye or on foot, always in the same succession with reference to one another. Geologists judge that the bottom ones were the older (deposited first) because there is no way of suspending the overlying ones above an open space while younger sediments were deposited over large areas beneath. That would indeed require a miracle! Successive layers, therefore, decrease in age before the present from the bottom upward, and everywhere the same distinctive kinds of fossils are found in the same layers while different ones occur above and below. Similar relationships of varying time spans are found in many parts of the world. Such relationships, matched with one another like pieces of a jugsaw puzzle, allowed students of fossils over a century and a half ago to work out successions that gave *relative* ages in terms of older than, younger than, and contemporaneous with. Until measurements from nuclear decay series became available, however, ages in years (before the present) could not be given. Now the consistency in sequence observed between atomic ages and fossil ages supports the evolutionary progression of life, the validity of nuclear geochronology, and the conclusion of both evolutionists and creationists that evolution needs lots of time--time measurable not in days but in hundreds or thousands of millions of years. The span of ages involved in the flat-lying rocks of the Grand Canyon alone is over 300 million years. The deformed rocks beneath them extend another 1,200 million years into the past.

6. Finally, I note the curious *creationist belief that evolution violates the second law of thermodynamics.* This law states that something called entropy always increases (in a closed system). In simplest terms this says, approximately, that free or available energy will be converted to bound, and thus unavailable, energy and that disorder will increase, to the extent order is not logically restored, by investments of free energy. Creationists, most notably H. M. Morris, an engineer who ought to know better, insist that life and its diversity violate the second law of thermodynamics, presenting this as evidence of supernatural intervention. This is a misconception on several counts. One defect is that the earth is not closed with respect to energy. Instead, our planet receives new energy from the sun at the average rate of 178 trillion kilowatts daily. This energy, through photosynthesis, drives all life processes in the same way a pump drives water uphill. It is, incidentally, also the source of all our fresh water, coal, oil, hydroelectric power, and much more. The second law applies only to the universe as a whole, or to such parts of it as may exist separately as truly closed systems. Morris, in his "Entropy and Open Systems" (*ICR Impact Series,* No. 40, 1976), not unexpectedly, takes issue also with this position. He fails, however, to allow for exchange between energy and order. A simple illustration of this phenomena is the following sequence: energy → bauxite → aluminum metal, in which energy is invested to transform disordered aluminum ore to the ordered elemental state of aluminum metal. When disorder sets in, as a result of the fabrication, use, and dispersal of beer cans from the aluminum metal, additional energy must be invested to restore order in the form of recycled aluminum ingots. Examples of this principle are seen throughout the universe. When an igneous rock crystallizes from a melt, order is created while free energy is consumed. The chemical elements themselves, the perception of whose ordered arrangement is one of the great artistic triumphs of science, are cooked in stars, novae, and supernovae as a product of the enormous temperatures found there. *Energy from the sun,* through photosynthesis, *is the driving force of life and its evolution.* Indeed, one could argue that the ever growing diversity of life is itself a

kind of entropic effect--where the maximal ordered condition might be visualized as the original population of simple unicellular organisms. In any case, through death, the molecules and elements of all living things are eventually restored to the physical system from which their substance was derived and in which they passed their lives. Entropy gets you in the end!

SUMMARY

Fundamentalist creationism is not a science but a form of anti-science, whose more vocal practitioners, despite their advanced degrees in the sciences and their bland debating postures, play fast and loose with the facts of geology and biology. Creationism has been thoroughly and repeatedly considered over the generations and rejected as being outside the realm of science by the world scientific community. It is not a *scientific* alternative to any form of evolution theory; and unlike much of the Bible, it has no bearing on morals or ethics. Like flat-earthism, which branded photographs of the earth from space as frauds, it is of interest only for its historical aspects and as a sociological aberration.

Indeed, creation "research" is a contradiction in terms, for there is no research to be done if the task is complete, perfect, and fully described in the Bible. What the research of CRS consists of, in fact, is poring through the works of evolutionists in search of trivial inconsistencies, no matter how ancient or offbeat, that can be used to reinforce their admittedly preconceived ideas.

The real issue is not whether science or divine revelation offers better insights to the truth or even whose version of divine relevation is to be presented as an alternative to evolution. There are two more important and more manageable issues. One is whether the scientifically and theologically unsophisticated student is to be confused by treating these two very different modes of thought as if they were susceptible to similar treatment in the framework of science --a distortion of both science and religion. The other is whether an extremist group of religious bigots shall be permitted to abridge the constitutionally guaranteed separation of church and state--whether fundamentalist Old Testament orthodoxy is to be granted a privileged and improper place in the public educational system. If a person wants to believe that the earth is flat, or that it and everything on it was created in six days, or to reject the proofs of its great age, he or she should have every right to do so. What he or she does not have a right to under the Constitution of the United States is to have such beliefs falsely presented as *science* in the classrooms of the public-school system.

The most serious threat of creationism is that, if successful, it would stifle inquiry. If everything were already completely set forth in biblical accounts, there would be nothing more to do, apart from suppressing heretical notions like natural selection while awaiting Judgment Day. We could close down the biological and medical research laboratories of the world and those branches of the school system that deal with subjects other than fundamentalist Judeo-Christian theology, industry, and driver training. The grand ideal of the Creation Research Society would have been achieved.

Evolution in the Twentieth Century

William V. Mayer

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Forget Darwin. Expunge from the record any and all references to Charles Darwin and his work. Then, look only at the data developed by biologists since the Scopes Trial in 1925. The inescapable conclusion: The theory of evolution will again emerge. Here, then, is highly recommended reading for everyone...the school administrator, school board member, legislator, parent, citizen, and even the teacher of biology. The author is professor of biology at the University of Colorado, and director of the Biological Sciences Curriculum Study.

In word-association tests, the name *Darwin* evokes the response, "evolution," and *evolution,* in turn, evokes "Darwin," as if one did not exist without the other. The confusion is similar to that of people who think Frankenstein was the monster or that the Ugly American was a reprehensible character. The customary linkage of Darwin with evolution fails to acknowledge that evolution was a concept long before Darwin and that the concept of evolution today bears about the same relationship to Darwin as today's quantum mechanics bears to Newton. Both Newton and Darwin were giants in their day; and just as Newton relied on Kepler and Einstein on Newton, so modern biologists have relied on the work of Darwin to develop a newer and more searching probe into evolutionary theory.

Advances in human knowledge that receive a "good press," or even a "bad press," tend to assume an importance out of proportion to what may be their actual contribution. Although Darwin's contribution to the theory of evolution was great, the publicity over *Origin of Species* was so intense that, more than a hundred years later, it still overshadows the contributions of all others. Such publicity clouds not only the lay mind but the professional mind as well, as evidenced by the following quotation (italics added) from an introductory college biology book published in 1971: "An outstanding step in the 1800's was *the introduction of the concept of evolution,* the theory that all existing types of animals and plants are derived from preexisting types. The *Darwin and Wallace theory* proposed around 1859 provided a fundamental framework and unifying theme for the study of biology." Here, supposedly scientific authorship regards evolution not only as a development of the nineteenth century but also as the product solely of Darwin and Wallace.

Once a contribution has received extensive publicity, any subsequent references to it elicit a response out of proportion to the original stimulus. The Scopes trial of 1925 was not so much a test of whether evolution could be taught in the schools but, rather, a showcase for the talents of William Jennings Bryan and Clarence Darrow. It contributed neither to the understanding of evolution nor to its teaching in the schools of Tennessee. In 1973 the Tennessee General Assembly again tried to legislate the teaching of evolution, and again the matter wound up in the courts--terminating when the United States Court of Appeals for the Sixth Circuit ruled that the Tennessee law unconstitutionally established a preference for the teaching of the biblical account of creation over the theory of evolution. Neither publicity nor the courts, however, determine the validity of a scientific theory.

To put the concept of evolution in perspective, we should be aware that attempts to account for the origin of life and the diversity of living things are probably as old as mankind itself. Among the early writing of the Greeks we find theories about the origin of life by Thales (640?-546 B.C.). Anaximander (611-547B.C.) had the concept of a gradual evolution from a formless or chaotic condition to one of organic coherence. He had an understanding of what today we would call adaptation, and an almost modern view of the transformation of aquatic species into terrestrial ones. By the time of Empedocles (495-435 B.C.), the evolutionary concept was crudely outlined, including the points that the development of life was a gradual process, that plants were evolved before animals, that better-adapted forms replaced the ill-adapted ones, and even including a vague anticipation of the concept of natural selection. If one were looking for the founder of the idea of evolution, Empedocles would be a far more appropriate choice than Darwin.

From Empedocles to the sixteenth century, the idea of evolution was completely suppressed by the Church, whose doctrine invoked the special creation dogma in its most literal form. Even the smothering theological climate, however, did not wholly suppress attempts to reconcile the idea of evolution with the scriptural account of creation. Gregory of Nyssa (A.D. 331?-396) thought that God had imparted fundamental properties and laws to matter, but what now existed on earth had developed gradually out of chaotic material. Augustine (A.D. 354 -430) perceived the biblical account of creation as allegorical, and Thomas Aquinas (A.D. 1225?-1274) supported Augustinian views by interpreting that the earth had received the power to produce organisms, and postulating that they were actually produced over long periods of time, and not in literal accordance with the conflicting timetables of Genesis.

In the late sixteenth century, Frances Bacon revived the idea of evolution; and through Kant, Descartes, and Leibnitz the road was paved for the great naturalists of the eighteenth century to attempt to account for how evolution had occurred. Linnaeus, while contributing the systematization of the plant and animal kingdoms, did nothing to foster the theory of evolution himself, although his system of classification did group organisms according to relationships. Buffon presented the concept of an environment that directly modifies the structure of plants and animals, and the subsequent conservation of those modifications through heredity.

A Darwin many forget, Erasmus Darwin, the grandfather of Charles, concerned himself less with the action of the environment on organisms than with the internal origin of adaptations. He clearly recognized the struggle for existence and, had he pursued that to its logical next step, survival of the fittest would have been his contribution. He further challenged the concept of a young earth and clearly expressed the idea that millions of years are required for the evolutionary process to occur.

It was left for Charles Darwin to develop over two decades the selection theories that provided a comprehensible "how" for the progression of evolution. Darwin's theory of evolution *by natural selection* (emphasizing that the theory of evolution itself was not Darwin's insight) was initially based almost completely on historical inferences, rather than on experimental verification of hypotheses. It stands as a unique triumph of that scientific method. Evolution is as essential for the comprehension of biology as is the atomic theory for understanding chemistry and physics.

Great synthesizing concepts are rare in science, but where they occur they lead to prediction, progress, and comprehension. In 1859, the publication of *Origin of Species* exposed Darwin's synthesis to public scrutiny and comment such as no evolutionary theory had been subjected to before. It was a document written not primarily for scientists, but for intelligent people everywhere. It spoke in the idiom of the mid-nineteenth century and contains the prejudices and the limited vision of the times, while presenting a wealth of data to support Darwin's selection theories.

The *Origin of Species* hit the Victorian world like a bombshell, with a predictable reaction from the evangelical clergy. The repercussions still continue into the latter half of the twentieth century. Darwin has been criticized many times by other scientists for the *Origin of Species*. From the vantage point of over a century, however, the only valid criticism can be summed up basically and nonpejoratively in these words: Darwin did not have the insights available to us in 1977.

What do we know today that was unknown to Charles Darwin? The publication of the *Origin of Species* evoked much discussion and gave rise to many intriguing problems. Those, in turn, induced biologists working in a wide variety of fields to focus attention on the implications of their work for the theory of evolution. Embryologists, biogeographers, paleontologists, systematists, comparative anatomists, and others began to compile impressive data augmenting the Darwinian position. But it was left to disciplines unknown to Darwin to present evolution in a twentieth-century context.

While pro- and anti-Darwin polemics were coming to a boil, Gregor Mendel, a monk who lived in what is now Austria, discovered within five years after publication of the *Origin of Species* the action of fixed, independently segregating units of inheritance--each governing a specific trait in an organism. Unfortunately, both his discovery and his method of presentation, relying heavily on statistics, were novelties in the realm of biology. It was not until about 1900 that biologists had become sufficiently receptive to Mendel's mode of analysis to rediscover Mendel's laws of inheritance.

The implications of Mendelian genetics, however, were not immediately apparent for evolution. As envisioned, natural selection could act only on existing variations and thus could choose traits only retrospectively. There was no apparent prospective design element in natural selection. Thus, biologists focused on traits that varied in continuous quantitative sequences such as human skin color, extending along a scale from albinism to melanism. Mendel and his earlier followers dealt with a single pair of heredity determiners (genes). One was received randomly from each parent, with the offspring showing the resulting genetic trait, such as round or wrinkled, yellow or green, as in Mendel's peas.

The implications of this work for natural selection were apparently contradictory. The hereditary characteristics, as perceived by Mendel, would be required to breed true and yet produce variation on which selection could act. It took a number of decades to resolve this apparent contradiction and to show that the qualitative traits necessary for natural selection were produced by a large number of genes (genotype) acting on the intensity of the appearance of a given trait (phenotype). Had these hereditary principles been discovered prior to the elucidation of the theory of natural selection, rather than in reverse order, the theory of evolution would have achieved more rapid acceptance within the scientific community and would have engendered far fewer polemics outside it. The relationship between evolution and genetics could be likened to the discovery, in geology, of the existence of relatively narrow bands, or zones, of earthquake activity and mountain-building many years before the discovery that the earth's surface comprises great platelike segments that slide and grind against one another, producing unrest in the narrow bands, or zones, that mark their edges.

Natural selection requires that environment pick and choose among a variety of genotypes. Mendel's studies, based on plants that were growing in a uniform enviroment, emphasized the deterministic influence of the genotype on the phenotype. Actually, only a few traits are determined in this fashion. Natural selection requires genetic determination of a range of organismic potential, and selection by the environment of the phenotype that ultimately develops. For example, one may have genes that predispose to obesity; but environment can prevent the realization of this genetic potential by limiting food. Regardless of the genetic predisposition, therefore, the individual remains thin. Thus, with the discovery of the polygenic nature of qualitative traits, and that the environment determines the pheontype by acting on the genetic potential of an organism, natural selection is buttressed by genetics. But all such principles of genetics were unknown to Darwin.

Even variability of that kind, however, is not sufficient to explain the wide variety of living things. No permanent hereditary effect results from the selection of variations that simply fluctuate around a mean. Mere phenotypic selection resulting from variable growing conditions in plants, for example, induces no new fixed varieties. What is needed is a genotypic difference that is abrupt, new, and capable of being fixed in the genetic information of the organism. The reshuffling of existing genetic information can be compared to playing cards. The fifty-two cards can be dealt in innumerable combinations, but they are, after all, the same fifty-two cards. For a new kind of game to evolve, something akin to a fifteen of spades is required.

In an analogous fashion, biologists who sought to account for the almost infinite variety of living things were searching for the evolutionary fifteen of spades. It was left to the Dutch botanist Hugo de Vries, at the turn of the century, to locate such a card. De Vries, like Mendel, worked with plants. Mendel used the garden pea, De Vries the evening primrose. In a population of primroses, De Vries observed plants that differed not merely in degree but in kind. Those distinct varieties bred true, or repeated themselves from their seed. De Vries called them "mutants," and considered them to be a new elementary species that had come into existence suddenly, in one generation. On the basis of his work, De Vries concluded that evolution occurred because of the sudden appearance of new varieties and not, as Darwin had supposed, because of the natural selection of fluctuating variations. Darwin had recognized what he called saltatory variations, or sports (mutations), but he felt they occurred too infrequently for them to affect natural selection. De Vries, on the other hand, held that mutations could produce distinctly different true-breeding types, which, if isolated, became an incipient new species immediately. For a while, the mutation theory of De Vries and the natural selection theory of Darwin were regarded as competitive, but later they were perceived as complimentary: Certain mutations yield characteristics that increase an organism's chances of survival; natural selection operates on those characteristics, and is therefore dependent on mutation as a source of variability.

With Darwin's theory of natural selection and De Vries's mutation theory, it seemed that a proper and simple mechanism to account for speciation had been provided. Science, however, is a probing process, and its course is littered with discarded theories and simplistic explanations. A mutation is a change in a gene. Most are so slight as to be unnoticeable, while a few are drastic and prominent; some are so traumatizing as to be lethal. But contrary to De Vries's opinion, while mutations are a raw material of evolution, they do not produce a new species as abruptly as he had envisioned. Thus, as scientists came to know more and more about mutations, and to produce them experimentally, they found that natural selection appears to "pick and choose" among variations in the phenotype so that the chances for survival of an organism in a particular niche are increased. With this realization, genetics and evolutionary theory fused by the 1930s, and their union contributed to many new disciplines--population biology, population genetics, molecular genetics, biochemical genetics, and molecular biology. Those newer disciplines, in turn, have helped to reinterpret and induce "hybrid vigor" in such older fields as ecology, morphology, and systematics.

Investigations in the new disciplines have focused attention on the population, not the individual, as the unit of evolution, with ecology influencing the statistical distribution of genes among populations. Molecular genetics explains and reinforces the mechanisms underlying Mendelian genetics. Molecular biology focuses on the structure of the cell components to uncover the code that determines the characteristics for each organism.

Focus on the cell itself solved the problem of genetic continuity, or how information is passed from parent to offspring. In other words, how does a chicken egg know how to produce a chicken? The logical focus for such investigation was on the cell nucleus because, in a male sperm cell, that is the major component passed to succeeding generations. The nucleus in a dividing cell passes through an orderly series of changes, as shown by Walther Flemming, a German biologist who published his results on the study of cell division in 1882. The process he called mitosis. Flemming's study of mitosis focused on the chromosomes, which appear during mitosis as tiny dark rods. As these replicate, one of each kind is passed to each of the two subsequent cells. By the early twentieth century, other investigators--notably Thomas Hunt Morgan and Walter S. Sutton--had established that genetic information is passed from parent to offspring by means of the chromosomes. Those structures were thought of as chains of genes and, as the location of the genes on the chromosomes was established, attention focused on gene structure.

O.T. Avery and others working at the Rockefeller Institute for Medical Research in New York are credited with the discovery, in 1944, of DNA (deoxyribonucleic acid) as the material of the gene. DNA is a long chain molecule made up of four different kinds of molecules called nucleotides. With this discovery, it was possible to begin to interpret the genetic message passed from generation to generation and to identify the code that determines the characteristics of a given organism. J. D. Watson and F. H. C. Crick, in 1953, determined the structure of DNA as a double helix, which could best be visualized as two spirals coiled together and linked by sequences of interlocking "crosspieces" representing the nucleotides--adenine, thymine, guanine, and cytosine. The comprehension of DNA as a double helix led to experimentation to solve the question of how equal amounts of genetic information can be placed in the two separate cells resulting from division if mitosis starts with only one of each DNA molecule. We know that both the quantity and quality of the DNA remains the same in cells derived from similar parent cells, and therefore, the explanation must account for maintaining similar amounts of DNA, regardless of successive divisions. The work of Meselson and Stahl at the California Institute of Technology in 1958 showed that the DNA double spiral unzips along its length and new nucleotides of the only kind that can make the proper bonding are then added to each separated chain to replicate the original molecule.

Scientists now had knowledge of how DNA was constructed and how it was replicated at each succeeding cell generation. But the question remained--how do the genes act in a cell to transmit the instructions they contain? It was known that every gene has two roles to play in the cell. First, it must pass on carbon copies of itself to all cells that descend from the original fertilized egg in the process of replicating DNA. Second, genes control all cell activity and, by their actions, every step of an organism's development.

The work of Beadle and Tatum in the 1940s showed that genes control biochemical reactions through their effects on enzymes. An enzyme is an organic catalyst that initiates and controls a specific chemical reaction within a cell. This work of Beadle and Tatum at Stanford University led to the "one gene-one enzyme" hypothesis focusing on the function of a gene as the formation of a protein. Scientists now believed that the gene in the nucleus is probably only a portion of the DNA molecule. Those genes, located in the nucleus of the cell, relay their messages to the other parts of the cell by building and dispatching messenger RNA, which, through other molecules in the contents of the cell, ultimately cause specific proteins to be made.

The entire chemical machinery of the cell seems to be controlled through DNA messages based on what amounts to a four-letter alphabet, the "letters" being the four nucleotides of DNA--adenine, thymine, cytosine, and guanine. If the primary role of DNA is to determine the exact nature of the proteins that are manufactured in any given cell, then the four-letter code must be able to determine the exact order of the amino acids from which proteins are built.

Scientists thus find themselves dealing with a four-letter DNA code to determine the exact order of the twenty or so amino acids that are used in synthesizing the proteins (including enzymes) of all organisms. If a given protein in a cell consists of a thousand amino acids arranged in a particular order, then the triplet code (only three of the four nucleotides are used in any given message segment) in which three nucleotide units are required for each amino acid specified, would require three thousand nucleotide units to form the protein. That is not hypothetical. In 1961, the code was cracked by Marshall W. Nirenberg and J. Heinrich Matthaei, working at the National Institutes of Health. We now know that the four nucleotides of chromosomal DNA, or messenger RNA, in various sequences of threes (triplets) communicate directions for the synthesis of all the cell's proteins. Such a control over protein synthesis amounts to the control, through enzymes, of all the chemical reactions of the cell and ultimately of the normal development of an organism. That control has focused attention upon changes in DNA as the raw material of evolution.

A number of parallel experiments were underway whose significance was not fully appreciated until the structure of DNA had been elucidated. In the late 1920s an investigator named Fred Griffith set the stage for genetic engineering, recombinant DNA, or gene-splicing as it is known today. Griffith's experiment involved two strains of pneumonia-producing bacteria, one of which was virulent and one of which was not. Nonvirulent *Diplococcus,* mixed with a killed virulent strain, resulted in a virulent *Diplococcus*. Not knowing about DNA or the possibility of its transfer, Griffith could only account for his results by assuming that the live, nonvirulent bacteria had consumed the killed, virulent bacteria and thus had assumed the characteristics of the latter.

Lederberg and Tatum, working together at Yale in 1946, discovered that genes could be transferred from one microorganism to another; later there was an observational confirmation that an actual physical bridge of living substance forms between two of the microorganisms with which they had worked. With the knowledge that DNA could be transferred from one organism to another, it was but a simple step to assume that human beings could do the transferring.

Scientists are now able to synthesize new genes in the laboratory, and the ability to transplant the genetic material from one cell into cells of a wholly different species, or to synthesize genes and transplant them, allows human beings to tamper with the evolutionary process to a degree never previously imagined. The ability to alter the genetic message so that it gives a new set of instructions to the developing organism makes it conceivable that defective genes can be removed and normal ones substituted in their place or, conversely, that an inadvertent new life form may be more deadly to human beings than any currently extant.

In June of 1974, scientists working in this field called for a voluntary moratorium on all such work until procedures could be developed that would minimize the dangers from the inadvertent creation of a virulent new organism. In June of 1976, the National Institutes of Health issued guidelines to govern recombinant DNA experiments in all research the Institutes helped support. Genetic engineering has given human beings the potential to formulate instructions to order, and to reduce the time span required naturally for evolution to a mere few generations. Thus, environment can be removed as an evolutionary factor and man has become an agent capable of developing new life forms and, perhaps, guiding the future course of evolution. Like nuclear reactions, the potential for both benefit and harm is thus placed in human hands. The possibility of eliminating genetic diseases is encouraging. The potential for creating monsters more devastating than Frankenstein ever dreamed of is alarming.

Despite the specter of evolutionary mechanism under human control in the future, the knowledge we have today allows us to account for both diversity and unity in living things. We know how the gene is copied at each cell division, how mutations arise, and how they are perpetuated as altered DNA. We understand why the gene is stable and how the accuracy of its copying is enhanced by several enzymatic repair systems that correct most errors. And we can now explain how the length of the DNA chain can be expanded to accommodate the additional genetic material needed for the evolution of higher organisms.

With that understanding, we can test major predictions from the theory of evolution. The first prediction that we could make from the evolutionary thesis is that the morphological and physiological differences among organisms are due to differences in their DNA. Thus, if the accumulation of mutations over a period of time leads to the evolution of a new species, the DNA in the new species should reflect those differences. The second prediction we could make is that the farther apart organisms appear on a tree of evolutionary relationships, the greater should be their differences in DNA. Those two predictions have been tested experimentally by the following technique: When two strands of the DNA molecule are separated, under the right conditions they will zip back together. If separated strands from two different organisms are brought together, they will zip together in the regions where they are complementary *but not in the regions where they are different*. Because of that we can now find out how much of the total DNA of any two species is alike by separating single strands of DNA from both and allowing them to zip back together when they will. How much pairing of the two strands there is indicates how close is the relationship of the two species. For example, the DNA of human beings bears no relation to that of bacteria, shows slight similarities to that of lower vertebrates, and is 99 percent comparable to that of the chimpanzee. Other experimental evidence comparing single proteins from different species shows that differences in the sequence of amino acids also reflect the divergence of the species in evolution.

Thus molecular genetics confirms precise predictions from the evolutionary theory and provides direct evidence for evolution--far more direct than the stepwise morphological variations and homologies cited by Darwin. Although the Darwinian evidence has been questioned, it is hard to deny the experimental evidence for evolution cited above. If we accept the validity of science as a means of understanding nature, the passage of time has provided more and more evidence in support of evolution so that we may now consider it as firm a law for biology as the laws of thermodynamics are for the physical sciences.

The extremely rapid growth of knowledge since 1930 about the mechanisms of evolution has not only confirmed the theory but has also detailed the processes involved in evolution. We now know that mutation, recombination, selection, and isolation are the principal mechanisms of evolution. Those mechanisms, acting over long periods of time, have produced new varieties and species. Higher systematic categories, such as genera, have been produced by adding to those four processes two more: the multiplication of populations with particular genetic characteristics; and the extinction of intermediate populations.

It is a long trail that the idea of evolution has followed--from Anaximander to the molecular geneticists. Developments in the past fifty years have been sufficient in themselves, however, to have spawned the theory of evolution, even if all contributions before 1920 were to be expunged from the record. Any student of morphology, systematics, comparative physiology, comparative anatomy, embryology, paleontology, molecular biology, molecular genetics, population genetics, population biology, biogeography, or a host of other disciplines cannot comprehend the subject without the theory of evolution as a unifying principle. Conversely, each of those disciplines, in itself, provides data in support of the theory of evolution. If the word *evolution* were to be removed from our vocabularies and laws passed that no courses in the subject could be offered in our schools, the same data, concepts, and implications would be derived again from the disciplines that have grown out of evolutionary theory in the last half-century.

But fortunately, there is no way that evolution can be legislated away. It is here to stay--a monumental accomplishment of many men and women both before and after Darwin.

Evolution, Creation, and Biology Teaching

Richard D. Alexander

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This article grew out of a series of three debates Alexander had with a creationist. After some general remarks about the theory of evolution, he takes a thorough look at some modern creationist arguments and how they may be refuted. Alexander also looks at erroneous aspects of creationist descriptions of natural selection. Experienced teachers of life science, as well as those preparing to enter the field, will find this article of interest.

Recently, creationists, antievolutionists, and others have sought to revive arguments that grave doubts should exist as to whether or not all animals and plants, and particularly the human species, are products of the slow, step-by-step, cumulative process of mutation and natural selection that biologists call evolution (Gish 1970, 1973; Levitt 1971; Macbeth 1971; Moore 1972, 1973, 1974; Moore and Slusser 1970; Spears 1972; Wade 1972, 1973; Lucas *et al.*, 1973; Peter 1970). Persons familiar with the data supporting evolution, and others who accept the views of professional biologists without reviewing the evidence themselves, have paid little attention to the creationists' arguments, which are essentially unchanged from those prominent a half century ago (Brown 1922; Dexter 1925; Rice 1925; Barker 1926; Wells 1926; Bush 1926; Linton 1926; Anonymous 1927; 1945). A certain proportion of people who are emotionally involved, probably some on each side, are unlikely to be swayed by arguments or data. Another group, to whom this essay is principally addressed, includes those who for one reason or another remain genuinely in doubt, or unable to satisfy themselves easily and quickly on this issue, and those who seek reviews of the evidence for teaching purposes.

Creationists have concentrated their efforts on secondary and primary school biology courses where they can involve those parents for whom this may become an emotional issue, both because of apparent conflict with religious beliefs and because parents may feel some responsibility to guard their younger children against exposure to certain issues or attitudes. Success is also more likely here than at college levels, because it is easier to enact legislation affecting primary and secondary schools, and to influence classroom materials through the control of school boards. Such efforts have succeeded temporarily in states such as Tennessee, where legislation was passed and later declared unconstitutional, requiring that creation be discussed as an alternative theory whenever evolution is discussed in public schools (Wade 1972); and California, where the state school board has required that creation be included in biology textbooks and other classroom materials discussing evolution (Forbes 1972; Dodge 1973).

Bills requiring discussion of creation in high school biology courses mentioning evolution are being submitted yearly to state legislatures. They are modified repeatedly to test what might eventually become acceptable to the legislature in each particular state. Recently, four such bills were presented to the Committee on Education of the Michigan Legislature: Michigan Senate Bills 66, 67; Michigan House Bills 4047, 4339, Jan. and Mar. 1973; one of these passed the House by a vote of 71-25. This is a pernicious move that calls for resistance. If evolutionists were attempting to require that evolution be taught it would be no less pernicious. When a creationist, Darwinist, Marxist, or supporter of any other theory defends his or her views publicly, he or she does everyone a service. But when anyone attempts to establish laws or rules requiring that certain theories be taught or not be taught, he or she invites us to take a step toward totalitarianism. Whether a law is to prevent the teaching of a theory or to require it is immaterial. It does not matter if equal time is being demanded or something called "reasonable" time, because there can be no reasonable time in such a law.

No teacher should be dismayed at efforts to present creation as an alternative to evolution in biology courses; indeed, at this moment creation is the only alternative to evolution. Not only is this worth mentioning, but a comparison of the two alternatives can be an excellent exercise in logic and reason. Our primary goal as educators should be to teach students to think, and such a comparison, particularly because it concerns an issue in which many have special interests or are even emotionally involved, may accomplish that purpose better than most others.

The human background is a central question in the lives of thoughtful individuals who wish to understand themselves and others. Society needs nothing more, perhaps, than a thorough comprehension of human tendencies, motivations, and possibilities. These are, in large part, the issues when one is contemplating the effects of human history upon our behavior. Creation and evolution in some respects imply backgrounds about as different as one can imagine. In the sense that creation is an alternative to evolution for any specific question, a case against creation is a case for evolution and *vice versa*.

With regard to creationist theories about life, we are in a peculiar position because many people are taught from childhood that there is a Creator, who is to be revered absolutely and unquestioningly. When creation theorists strive to introduce creation into the classroom as an alternative biological theory to evolution they must recognize that they are required to give creation the status of a falsifiable idea--that is, an idea that loses any special exemption from scrutiny, that is accepted as conceivably being false, and that must be continually tested until the question is settled. A science classroom is not the place for an idea that is revered as holy. If efforts to keep creation and Creator in such status, in regard to the history of life on earth, accompany moves to incorporate them into science teaching in public schools, then such efforts would properly be viewed as efforts to introduce religion into the classroom.

The evidence supporting and detailing the facts and theory about evolution can be found in any introductory biology textbook, such as that by William Keeton (1974). The evidence, however, is complex and multifaceted. This is why evolutionary theory will always remain vulnerable to distortion by those who insist upon a quick, simple review. This essay is not intended to provide a description of the range of evidence supporting evolution. On the other hand, the evidence against creationism, as espoused by members of the Creation Research Society and others, involves relatively simple arguments and can be summarized easily. Creationist arguments are few, and they are repeated almost without change or development throughout the creationist literature of this and other decades. Their applicability to biological questions depends wholly upon a number of highly questionable or demonstrably false dichotomies. Creationist arguments can be shown to involve significant retreats, indicative of untenable hypotheses. By treating creationism as al alternative to evolution, teachers have an excellent opportunity to demonstrate the strength and usefulness of the evolutionary model of life as a framework for biological investigation and understanding.

Comparisons between the views of creationists and evolutionary biologists are also useful because the most important change that can occur in biology is a dramatic updating of evolutionary theory and teaching. The views of evolution that I see publicized by the creationists of this decade are antique views, with little relevance to what is going on in biology today. They treat the controversy between evolution and creation as if it were static--as if nothing had happened since 1859--when, in fact, evolutionary theory has advanced steadily since Darwin. In contrast, creationist theory has inexorably retreated toward sets of problems and ideas on which there is yet no significant evidence.

The theory of natural selection is being used today to develop and test predictive hypotheses about sex ratios, sexual dimorphism, sexual competition, sexual selection, parental investment, nepotism, social reciprocity, group-living, altruism, senescence, rates of infant mortality, and other problems to which it was not being applied significantly as recently as a decade ago. Unfortunately, high school biology teachers, who completed their formal training in biology before this new wave of evolutionary ecology and social biology had begun, are being dragged into ancient arguments and diverted from the truly exciting aspects of modern evolutionary biology.

Some General Remarks About Evolution

The massive volume that Charles Darwin published in 1859 resulted from nearly 20 years of field observations, comparisons, experimentation, and logical thought about the nature of living organisms. In it Darwin expounded his theory of evolution by natural selection. In the Galapagos Island region, he had noticed that species, believed at that time to be immutable, were in some cases more similar to one another than in other cases. Sometimes he could not tell if two populations were parts of the same species or parts of two different species. He also noticed that island species, or populations, were more similar if the islands were closer together; and that they were more similar when they occurred in different climatic regions on the same continent than if they occurred in the same climatic regions on different continents. These early observations and comparisons led Darwin to suppose that perhaps species are not immutable after all, but changeable, and that one species may sometimes give rise to two or more species. Eventually he decided that the process of change involved in this speciation, or species multiplication, must result because variants exist within every species; some variants out-reproduce others; and which ones out-reproduce in any given time or place depends upon the environment. This process of natural selection of variants, which he compared to the artificial selection that man carries out on his domestic animals and plants, would cause populations on different islands to diverge unless they had chances to interbreed; this, in turn, would cause speciation to happen whenever accidental separations lasted long enough.

From this reasonable but startling beginning, Darwin went on to even more astonishing postulates, including the following:

1. All attributes of living organisms might be the result of a cumulative process of natural selection, extending backward through time to the beginnings of life on earth.
2. The major groups of organisms alive today differ from one another because they got separated during speciation processes in the distant past.
3. The entire fossil record is a remnant from the operation of heritable changes, natural selection, and isolation in a succession of past environments. Significantly, he noted that the fossils of a given continent generally resemble the living organisms of that continent rather than the fossils of any other.

From this beginning by Darwin, we derive the three major areas of investigation in evolutionary biology: (1) speciation, or how species multiply; (2) adaptation, or precisely how natural selection works; and (3) phylogeny, or the tracing of the patterns of evolutionary change through time. For the first several decades following Darwin it was phylogeny, and the search for more fossils, that were emphasized in biology. Later, speciation became an enormously popular area of investigation. Today, the study of adaptation, or the predictive and analytical value of natural selection, is paramount.

Darwin's combinings of facts, theories, hypotheses, conjectures, speculations, and guesses made sense in 1859, and they make sense now. Darwin's arguments and his methods have been tested, retested, examined, discussed, and refined by perhaps the greatest army of diligent and skeptical investigators ever to examine any testable hypothesis in the history of man. No evidence is available to deny the volutionary process that is accepted as the working hypothesis of probably more than 99% of the active investigators in biology today. Thus, biologists pay scant attention to the arguments of the few anti-evolutionists. What they have learned about biology and evolution leaves them convinced that evolution is the framework within which they must operate; they have no uneasiness that what they are doing will be much affected by anything that could be said in brief oral debates or dissections of the arguments of creationists.

Biologists also know that, through their journals and professional meetings, they will root out errors in their findings. On the whole, they subscribe to George Gaylord Simpson's simple definition of science as a self-correcting method of finding out about the universe.

If evolution involved only fruit flies and cabbages, creationists would not attempt to have laws passed saying which theories must or must not be mentioned in classrooms. Anti-evolutionists and creationists are concerned because ultimately the same kinds of questions and tests that evolutionary theory uses to analyze the various other organisms in the world are likely to be applied to efforts to understand ourselves. They recognize the possibility of conflicts between evolutionary theory and their particular religious or belief systems. Such conflicts may often occur when the two systems of explanation are being used to explain or reconstruct human history. No conflict exists, however, between evolution and religion (or any social, political, or economic ideologies) when the latter is concerned with plans or goals for society, or the future of human behavior. Evolution is an explanatory theory about history. Anthropologists, most of whom accept that humans have evolved, ultimately must examine tendencies toward having certain kinds of ideologies as products themselves, directly or indirectly, of the evolutionary process. They began long ago to investigate religion in that fashion. Such investigations have an unnerving aspect. But they also have an intriguing quality. Consider the paradox of an organism possessing some quality of self-awareness, trying to analyze itself, using for the analysis the very attributes that are to be analyzed, when one of the most prominent of those attributes is resistance to any such analysis. That is the most difficult challenge we are likely to extract from this universe for a long, long time.

These are the difficult problems that every thoughtful biology teacher has to consider in order to discuss organic evolution in the classroom, because evolution leads inexorably to the analysis of human beings. In fact, revolutions in our thinking about human behavior have already begun, chiefly within evolutionary biology; part of the evidence is contained in papers published by Hamilton (1964-1967), Williams (1957-1975), Trivers (1971-1974), Alexander (1971-1977), West-Eberhard (1975), and Wilson (1973-1975). Such revolutions can be productive, so long as they remain in the realm of open scientific debate, and so long as they never lose the quality of self-correction. But biology teachers assume an awesome responsibility when they undertake to discuss the relationship of human history to human behavior in terms of possible and probable causes, including Darwinian or natural selection.

A Statement of Modern Evolutionary Theory

Darwinian theory, as used by evolutionary biologists today, is simple to state, difficult to apply, and astonishing to contemplate. The evolutionary process from which it stems derives from the interaction of five basic phenomena.

1. *Inheritance:* All living organisms (phenotypes) are products of the interaction of their genetic materials (genotypes) with their developmental (ontogenetic) environments; these genetic materials can be passed from generation to generation unchanged.
2. *Mutation:* The genetic materials do change occasionally, and these changes are in turn heritable.
3. *Selection:* All genetic lines do not reproduce equally, and the causes of this variation may be consistent for long periods.
4. *Drift:* Genetic materials are sometimes lost through accidents, which are random or nonrepetitive in their effects on populations.
5. *Isolation:* Not all genetic lines are able, for various intrinsic and extrinsic reasons, to interbreed freely, and thus to continually reamalgamate their differences.

These five phenomena have all been demonstrated repeatedly, and can be demonstrated at will, as can their various interactions. No living things have been demonstrated to lack any of them, or are suspected to lack any of them. Hence, they are the factual basis of evolution.

Of the five main components of the evolutionary process, natural selection, or the differential reproduction of genetic variants, is almost universally accepted as the guiding force. The reasons for this assumption, which are not widely discussed, but which are crucial to the understanding of evolution, are: first, that altering directions of selection apparently always alters directions of change in organisms (although, because of genetic specialization or the absence of appropriate mutants, possibly in some cases only after delay); second, that the causes of mutation and the causes of selection appear to be independent; and, third, that only the causes of selection sometimes (but not always, of course) remain consistently directional for relatively long periods.

Mutations are most often caused by atmospheric radiation. Selection is caused by an updated version of what Darwin termed the "Hostile Forces of Nature": climate, weather, food shortages, predators, parasites, and diseases. This list implies competition for resources, such as food, or protection from the other hostile forces; accordingly, for all sexual species, we must include as a selective factor competition for mates, and for the best mates.

Because directions of mutation evidently remain random in regard to directions of selection (although not necessarily in any other respect) mutational changes as such are independent of adaptation, or the fine tuning that organisms exhibit in response to their physical and biotic environments. The same is true of genetic drift, for its causes are by definition without cumulative directional effects on the genetic materials. Thus, as evolution proceeds mutations must increasingly tend to become deleterious, and their rates have likely been severely selected downward. Also, directional evolutionary change has to be caused by directional selection. The only apparent exception is the concept of selection suddenly becoming absent in the environment of a complex organism with mutational changes then leading to steady reductions in complexity. Although this effect has sometimes been postulated when some particular selective pressure has evidently disappeared (e.g., reductions in size and complexity of human teeth with the advent of cooked food, or disappearance of eyes in cave animals), such cases are more appropriately explained as changes in directions of selection. In no way do they support an argument that selection itself somehow mysteriously disappeared from the organism's environment. When one direction or force of selection is removed from the environment of a species, the effect is to cause other previously opposing forces to become more powerful or effective.

These are the reasons, then, for the common tendency to refer to the theory of evolution as the theory of natural selection. They include the assumption that long term evolutionary changes result from the effects of natural selection across long periods of time (see arguments below on this question). Refinements of evolutionary theory since Darwin have chiefly involved new understanding of adaptiveness from short-term studies of the selective process, and comparative studies of function. The results of these studies lead us to the conclusion that to apply evolutionary theory we must focus our attention on the causes and effects of differential reproduction.

Modern Creationist Arguments

Following is a list of the usual creationist arguments. All of them may be found in the controversies of the nineteenth century and the early twentieth century, as well as in the more recent references cited earlier. These arguments include: (1) Information can be divided into facts and theories. (2) Evidence can be divided into that which is conclusive and that which is only circumstantial. (3) Facts are derived only from conclusive evidence; and (4) Conclusive evidence comes only from direct observations and experiments. (5) Since the essence of science is repeatability, and (6) Repeatability necessarily involves experimentation, which can only be carried out through direct observation, then (7) If a conclusion does not come from directly observable phenomena, it is not scientific because the evidence is only circumstantial. Hence, (8) Comparative study of the present cannot lead to facts about the past; (9) Darwin's comparative method, by which he "discovered" evolution and speciation, is neither scientific nor conclusive; and (10) We cannot study the past scientifically, especially not the distant past. (11) Questions about life can also be divided into "mechanisms" and "origins," or "means" and "ends." (12) General evolution or macro-evolution (ends) cannot be equated with natural selection, special evolution, or micro-evolution (means), for (13) Natural selection deals only with mechanisms, not with origins, and (14) There is no scientific evidence about the origins of kinds of life. (15) Evolution refers to a progression from "amoeba to man" but (16) Selection cannot be demonstrated to cause new organisms or new species, rather it is (17) Just a variation on a limited set of themes. (18) Change in living things can thus be divided into "within-kinds" change and "between-kinds" change. (19) Only "within-kinds" change can be observed directly; and (20) There are no genetic connections between major groups. (21) Mutational changes do not link major groups; nor do chromosomal rearrangements or ploidy. Therefore, (22) Natural selection is different from evolution, and (23) There is no scientific evidence about "between-kinds" change. (24) The fossil record, which might be used to support evolutionists on the gradual nature of evolution, is woefully incomplete; (25) What is missing are all of the links or postulated intermediates between major groups. (26) All known dating methods are notoriously inaccurate; and (27) There is evidence both of a widespread flooding and of overlap of man with trilobites. (28) Evolution also means progressive change, but the only real source of variations upon which selection can act are mutations, and (29) All mutations are deleterious, as is witnessed by the reversion to the "wild state" by all organisms once they are released from artificial selection. Therefore, since (30) All known change in life is degenerate (because all mutations are deleterious) and (31) All known change in non-living matter under natural conditions is also from complex to simple, (32) It is doubtful whether even natural selection can be used to explain anything at all about life. (33) The scientist is like a fisherman who uses a two inch mesh in his net; he cannot catch fish under two inches in size. (34) Creation is the superior theory because it accords with the gaps in the fossil record and can be used to explain every difficulty that confronts an evolutionary theory.

Permeating these arguments are three principal themes. The first is the idea that there are basic dichotomies in the nature of questions about the history of life, and that although support for a selective mechanism of short-range or minor change may be justified, nothing is thereby suggested about long-range or major change (see arguments 1-23, 33). The second is the argument that the fossil record is essential to evolutionary theory, yet is incomplete in ways that support creation and diminish evolution (24-27). The third is the assertion that all mutations are deleterious and all change by selection therefore degenerate unless it results from created variation as opposed to environmentally induced mutations or novelties (28-32).

Refuting Creationist Dichotomies

Facts and theories are not separated by a magic line. There is no magical or profound difference in what one does with these two concepts. Scientists deal in probabilities. Arbitrarily, scientists have chosen the levels of 95% probability and 99% probability as appropriate confidence levels in statistical analyses of their data. They require that the results obtained in their tests are only 5% or 1% likely to have resulted from chance alone. They call this a positive result, even though something remains unknown about the situation that somehow accounts for that last 5% or 1%. Such a result does not mean that the problem is solved. It simply means that one can proceed to the next step in the investigation with some confidence--95% or 99%, to be "exact."

The creationists' arguments suggest that a fact is something that, once discovered, is kept forever like a coin or a preserved butterfly. Not so. Nothing is irreversibly factual. Any fact may turn out not to be a fact at all; and in scientific investigation the only useful thing one can do with a fact is to use it to build better or more complete explanations. What researchers do with facts is establish the next line of hypotheses. And if their "fact" proves vulnerable, they discard it and start over. It is a fact that 100% certainties are obvious only in useless tautologies such as:

Hairless men have no hair. It is a fact that life insurance companies make money by operating on probabilities.

Conclusive evidence and circumstantial evidence are not separated by a magic line. Creationists distinguish between what they call direct or conclusive evidence and circumstantial evidence. So do courts of law. But there is a large difference. Courts admit that no magic line separates the two. Sometimes one cannot tell if the evidence is direct or merely circumstantial. Moreover, courts recognize that facts can derive from circumstantial evidence. People are still sentenced on circumstantial evidence.

We do not know who our relatives are from direct knowledge; we must rely upon what others have told us. Yet, we all consider that we know such things beyond significant doubts. In all likelihood no one ever did an experiment on whether or not the sun would rise the next day, yet we regard it as a fact that the sun rises each day. We do so because we have repeated the observation so many times as to render completely trivial the likelihood that it is accidental or random; but we have not thereby *eliminated* the *possibility* that the sun will not rise tomorrow.

There is no fundamental difference between the comparative method and the experimental method in biology. Both experiments and comparative studies attempt to discover statistically significant differences between sets of observations. The distinction is not in the amount of control or the precision of the results, but in the presence or absence of manipulation and in the usual kinds of controls employed. In experimentation, we deal with phenomena that can be manipulated, sometimes to make the comparisons easier or quicker, or more likely to yield unequivocal results. We depend upon comparisons without manipulations when we must--when, for example, we are dealing with long-term phenomena, or with variables whose effects cannot be eliminated and so must somehow be randomized.

The ideal test of the effectiveness of seat belts in reducing deleterious effects of automobile accidents would be experiments in which groups of identical automobiles driven by groups of drivers identical in weight, height, and other attributes were caused to have identical crashes. We cannot set up such experiments, but we do not simply give up on making decisions about seat belts. Instead, we search for other methods. Experiments with dummies and animal substitutes are useful. But the most important information probably has come from comparisons of unplanned accidents in which seat belts are (1) used and (2) not used. Such comparisons represent precisely the kinds of studies used by evolutionists to solve problems about long-term processes. By making appropriate comparisons we use the *natural experiments,* just as Darwin developed the theory of natural selection by comparing variously diverged populations with varying likelihoods of exchanging migrant individuals.

The problem with natural experiments is that they are not designed to answer the particular questions we want to answer. Sometimes, we can answer a question more precisely with specially designed experiments. It is not the precision of the results that represents the difference between the comparative method and the experimental method, however, but the difficulty of discovering how to make the natural experiments answer our question. This involves chiefly the manner in which we control the experiment not its precision. One controls a natural experiment not by *eliminating* the effects of irrelevant or confusing variables, as in a laboratory experiment, but by *randomizing* them.

Creationists' distinctions between origins and mechanisms depend upon all the other dichotomies. One must always ask: Origin of what? How does one tell whether he is talking about origins or mechanisms? We can sometimes demonstrate that differences between traits in organisms are due to genetic differences that derive from mutations, and some creationists do not deny this. But they distinguish between origins of *major* organs, or *major* traits, and mechanisms. Moore (1958) argues that it is scientific to require the evolutionists to reconstruct each case of speciation. Unless one can tell precisely how and when and where each species formed he suggests, to talk about speciation as a process is unscientific. Furthermore, since these questions about long-term events like formation of major organs or speciation, cannot be answered, Moore contends that such events must be as easily attributable to creation as to evolution.

Requirements that every case of long-term change be reconstructable in detail from direct observation, however, are approximately as scientific as suggesting that life insurance companies cannot make money unless they know how and when each person insured is going to die; or that we should not fasten our seat belts until the ideal experiment, described earlier, has been carried out. Insurance companies in fact make money by knowing on average when deaths are likely. Evolutionists make progress in understanding the attributes and history of living organisms using the same kinds of information.

Erection of false dichotomies in efforts to employ creation as a theory explaining life has forced creationism to undergo significant retreats. Creationists argue as though evolutionary explanations and creationist explanations are both static, neither advancing and neither retreating. This is not true. With the adoption of an attitude demanding (and admitting) verifiable evidence both for evolution and for creation, creationists were forced to acknowledge existence of the process they came to call "micro-evolution." "Micro-evolution" is synonymous with the evolutionary process evolutionists theorize can be projected in a uniformitarian fashion to explain life in general. This left the creationists defending creation only against "macro-evolution" or long-term change, which they argue cannot be investigated scientifically. Ironically, Darwin, ignorant of both the genetic basis of life and the nature of mutational change, modelled the long-term process of speciation by comparing near and distant island species as early as 1837 (Lack 1961), and may have been led only subsequently to his theory of both short- and long-term change by selection (Darwin 1859) and the slow divergence of populations in different localities with different constellations of selective forces.

Distinguishing macro- and micro-evolution forced creationists to draw the line between these phenomena. Initially, they drew this line between "within-species" and "between-species" changes, contending that these two kinds of changes were not due to the same phenomena because species were products of creation. As biologists' understanding of species developed, however, it became clear that although species ordinarily do not interbreed in nature they can often be caused to do so by altering their evnironments or forcing them together in the laboratory. In general, the more similar two species are, the more likely it is that they can hybridize, and that the hybrids will be fertile. Thus, no absolute genetic gap exists at the species level. It is also well known that when two different individuals in the same species are mated to produce hybrids, the hybrids are likely to be intermediate in some characteristics, like one parent in some characteristics, and like the other parent in others. The same is true when two species are hybridized.

Moreover, every biologist studying species in any group of organisms finds some populations for which there is no way of deciding whether or not they have achieved full species status, regardless of how that criterion is established. Therefore, every degree of difference, evidently down to the level of individual mutations, exists between diverging populations; and there are numerous cases in which the irreversability of the divergence of populations is uncertain, depending upon external environmental events such as the permanence of geographic or ecological barriers, which are not entirely predictable.

Contrary to creationist arguments, all of these facts indicate that the differences between species are, like those between individuals within a species, simply accumulations of mutations. Thus, the idea that reproductive barriers between species are the result of anything alien to the basic evolutionary process as we know it, is unsupportable; evidence for the opposite conclusion is abundant.

In view of this evidence, supporters of a theory of creation have retreated in two ways. First, they have centered their defense farther up the taxonomic hierarchy, sometimes referring to the genus rather than the species when speaking of the probable products of creation. Second, they have tended to become vague about the exact level at which micro- and macroevolution become distinct from one another, often speaking of "within-kinds" and "between-kinds" change without defining kinds. In still other instances, they suggest that what was created, or what evolutionary theory cannot explain, are "major groups."

The species concept, with all its difficulties, has the real correlate of reproductive isolation under natural conditions, sometimes difficult to apply, but directly observable whenever the species involved breed at the same times and places. Genera, on the contrary, are simply groups of species placed together because of overall similarity, with generic limits a matter of opinion and convenience in classification. In fact, hybrids between species belonging to different genera are common (Gray 1954; 1958), and hybrids have even been obtained between species of fish belonging to different families (Hubbs and Drewry 1960). Major groups are even less definite, and fewer in number. A creationist theory restricted to "major groups" is much less important than one presumed to account for lower-level groups, and too indefinite to be meaningful.

Sometimes, alterations of our views about presumed long-term trends in evolution, such as orthogenetic and "progressive" trends, the idea that ontogeny recapitulates phylogeny, or the particular phylogenetic constructions proposed for certain groups (e.g., horses, see Macbeth 1971) have been regarded as casting doubt on evolutionary theory in general. Such arguments lack foundation because it is highly unlikely that anything as complex and poorly documented as the long-term history of life could be reconstructed without many errors and false starts; and the revisions proposed do not suggest causes other than natural selection. Moreover, every time supposed special features of long-term evolution like orthogenesis, progress, and recapitulation are diminished in importance or eliminated, the argument is strengthened that macroevolution is nothing but micro-evolution over longer time spans.

When a theory must constantly retreat, this is evidence in favor of its alternatives. In this case, it is not only clear that there is no definite line between natural selection and evolution, but that creation must be applied at some entirely different level in this universe than that of explaining existing traits and kinds of living organisms if it is to remain a viable idea.

Evolution and the Fossil Record

The fossil record is not really necessary to defend an evolutionary explanation of life. Nevertheless, it is extraordinarily supportive of evolution. In terms of whether or not long-term evolution by natural selection has occurred, there simply are no significant problems, just as there are no real missing links between man and proto-man. The important point is not exact dates, exact sequences, or directionality of changes. The dates themselves, or changes in dating, are not challenges to evolutionary theory, though they are often so headlined in the newspapers. The important points are two. First, dates, sequences, and directional changes, as known, generally accord with one another. Estimates of relative ages based on location in the ground roughly match the estimates of relative age based on the nature of the fossil. When isotope dating methods became possible the relative ages determined by those methods for the most part matched what had already been learned. Yet the chances of the above three complex kinds of data matching by accident, in the fashion required to support evolutionary theory, are infinitesimal.

The second important point about paleontological evidence is that due to the incompleteness of the data and the imperfection of the methods of measurement available at any given time, it is entirely predictable that slight mismatches of fossil data will occur. Moreover, increases in numbers or prominence of such cases should occur sometimes when new data or methods are acquired. Such inconsistencies do not support evolution; neither do they negate it. They always must be considered in light of the overall consistency of paleontological evidence and the apparent incompleteness of data on the particular problem involved. Most important is what happens to such cases after they have been identified. Do they tend to disappear as more knowledge is gained? Such trends cannot fail to support evolution. In the face of such trends even the persistence of a "hard-core" of inconsistent cases fails to detract from evolutionary theory. Moreover, to support a creationist theory an opposite trend would be required: a growing number of cases inconsistent with evolution that fall into a definite pattern supporting a creationist explanation. Such a pattern already exists to support evolution, based upon thousands of separate cases. Hundreds of new paleontological discoveries are made each year by hundreds of paleontologists competing with one another to discover what really happened during the history of life on earth. The number of problems solved by these discoveries far exceeds the number raised.

Gaps exist in the fossil record for the following reasons:

1. Not all species are preserved.
2. The more time that has elapsed, the more chance there is for loss.
3. Earlier animals tended to be softer and small, hence less likely fossilized.
4. Evolution is sometimes more rapid, giving less opportunity for fossilizing some of its stages.

Gaps exist between major groups because:

1. We define groups as those between which gaps still exist.
2. Intermediates between major groups, as one would expect, tend to be more ancient than those between groups lower in the taxonomic hierarchy and accordingly more recent; hence they are less likely available as fossils.

We reconstruct the past just as we predict the future. Our information is incomplete in each case, and we can gain new evidence in each case to test a model or a prediction. Complaints are made about reconstructions based on sequences developed from data fragments from different places. Perhaps it would be optimal to be able to reconstruct a complete sequence from one beginning, but we really have no reason to expect animals to have been fossilized in perfect arrangements for such a purpose. To argue that the past cannot be reconstructed is even less reasonable than to argue that the future cannot be predicted.

Moore (1974) says that a major prediction of creation theory is that there will be gaps between distinct kinds of forms of living animals and plants, with different degrees of variability within known kinds of animals and plants. But does such a theory predict what kinds of gaps will occur? Evolutionary theory predicts correctly that there should be more fossils of bony and shelled animals and more gaps in soft-bodied forms, more fossils of recent forms and fewer of more ancient forms, and erratic gaps because of irregular spacing and varying severity of environmental catastrophes and changing rates of evolution in different circumstances.

If as time passes, no one finds an exception to meet Darwin's challenge of universality, the theory of evolution by natural selection is further confirmed. As additional fossil discoveries continue to increase the number of attributes of organisms for which extinct intermediate forms are known--such as kinds of legs and wings, sizes and kinds of skulls--it becomes increasingly probable that the structures of organs for which no intermediates between extant forms are known were also once represented by intermediates. As the proportion of living forms unrepresented by extinct forms is steadily reduced by fossil finds, as has happened continuously since Darwin's theory was first published, the theory of gradual evolutionary change is increasingly supported. Whenever a specific gap used by creationists as evidence of creation is filled, the power of creation as an explanatory theory is further diminished.

Erroneous Aspects of Creationist Descriptions of Natural Selection

Change by natural selection is not degenerative. Creationists argue that all "constructive" genetic variation was created, that all mutations are deleterious, and that all change by selection acting on mutants must be degenerative. These arguments are paradoxical for several reasons, including:

1. Selection can be shown to act upon any existing variations as well as upon demonstrably novel mutations, simply by altering the environment.
2. Some new mutations can be shown to be identical to alleles already existing (mutations are evidently recurrent).
3. What is deleterious in one environment can be shown to be advantageous in another.

Thus, a line cannot be drawn between existing variation that might have been created and that introducted by recurrent mutations, and whether a variant is advantageous or not depends entirely upon its environment and not upon whether it is a part of what appears to be the existing "natural" variation within a species or a known recent mutant.

Change by natural selection is not progressive, except in the sense of improving adaptiveness. There is no implication of progress from simple to complex, from amoeba to man, nor is there any sense of better or worse, except in relation to adaptiveness to the immediate environment. Accordingly, changes from complex to simple in modern organisms are not evidence against evolution but cases of evolution. When organisms that have been selected by man are released from that selection they are being returned to the environment where their original attributes were acquired, and through natural selection their original traits, or similar traits, once again become prominent.

Natural selection and not creationism leads to testable theories about the evolution of many aspects of life. What does it mean if such phenomena as sex ratios, amounts of sexual dimorphism, and correlation between breeding systems and parental behavior can be explained by the same theory in animals as different as primates, ungulates, and pinnipeds (Alexander, *et al.* in press). It means that the theory has general applicability. It also means that we have probably found out about something that has been happening gradually in each of these groups for a long time, beginning long before anyone was watching them. The only theory that has successfully made such predictions is natural selection. This indicates that natural selection can be extended into the past beyond our power to observe its action directly. Continuous ranges of variation in characters involved in phenomena like sexual dimorphism can demonstrate that sexual dimorphism evolves very slowly. So from the study of adaptation as well as the study of speciation we can successfully link short- and long-term evolutionary changes and prove that the two are not different.

Darwin (1859) specified the means for falsifying the idea that observable small changes lead to large changes which take so long that they are not directly observable: "If it could be demonstrated that any complex organ existed, which could not possibly have been formed by numerous, successive, slight modifications, my theory would absolutely break down."

Hybridization experiments showing that big differences between species are due to differences in large numbers of separately heritable genes, as well as the general relationship of genes to the development of the phenotype, indicate that Darwin's next statement, "But I can find no such case," would represent the conclusion to which modern biologists would also be drawn. Similarly, the alteration of complex organs by matings of individuals in which the organs differ slightly is a clear support for the idea that such organs have evolved through accumulations of small changes.

Evolutionary theory invokes only demonstrable mechanisms. A fundamental difference between evolution and creationism is that creationism invokes processes and mechanisms that cannot be demonstrated, and that no one has ever observed; evolutionary theory predicts on the basis of processes and mechanisms that everyone can observe and verify today. Evolutionists do not argue or require that no unobserved or unobservable, unverified or unverifiable processes and mechanisms can possibly occur. They simply build their models on the basis of the observable and verifiable, and continue to test those models. As long as predictability keeps on increasing, they keep on refining and adjusting their models and testing the new versions. No creationist has suggested an alternative testing procedure.

Natural selection is not an untestable hypothesis. A common objection to the theory of natural selection is that it is a tautology: In survival of the fittest, the fittest survive. Why do they survive? Because they are the fittest. The circularity of these statements has led people to say that natural selection explains nothing because it explains everything. Some of the same people also say that Darwin did not provide a means of falsifying his hypothesis--that he did not tell us about anything that could not be true if natural selection occurs.

We can dismiss the latter contention and introduce a compelling and provocative aspect of evolutionary theory by considering a bold challenge issued by Darwin (1859); it was:

> If it could be proved that any part of the structure of any one species had been formed for the exclusive good of another species, it would annihilate my theory, for such could not have been produced through natural selection.

Darwin thus provided, in 1859, a means by which his theory could be falsified, and he so identified it. (He said, in effect, that his theory, if correct, should explain everything *observable* but not everything *imaginable*. Moreover, he did not say that an exception to his view of adaptation would weaken or diminish his theory, rather that it would annihilate his theory. Darwinian theory thus demands a selective background for the traits of all organisms and simultaneously rejects the possibility of certain kinds of altruism as evolved adaptations (but does not thereby exclude them from the behavioral repertoires of modern humans, who need not be bound by their evolutionary history). In other words, Darwinian evolution was, by Darwin himself, placed in a maximally vulnerable position by his clear exposition of what is required of living things if it is to be upheld. Darwin did tell us how to falsify his theory.

Although Darwin spoke only of "structure" we are obviously forced to expand the challenge to include all traits, whether morphological, physiological, or behavioral. Although he spoke only of altruism between species we cannot avoid the fact that all forms of genetic or reproductive altruism *within* species are also contrary to evolutionary theory, and should exist only as a result of accidents, or sudden environmental changes rendering an organism temporarily "maladapted." The human environment, however, includes our ability to reflect consciously and plan deliberately; we can thwart the adaptive background of our genes.

One more thing needs to be said about the supposed circularity or tautology of the phrase "survival of the fittest." If we never could *predict* differential survival or reproduction, but could only analyze it in retrospect, this criticism would be justified. Of course, this is not so. We can make countless accurate predictions from variations in the attributes of organisms, such as in an environment including sharp eyed hawks and a white sand substrate, white mice will out reproduce black mice. Thus, the concept of natural selection does not require circularity.

Darwinism is not an ideology. Darwinian natural selection may provide the core item in analyzing the causal history of the traits of living organisms, even including the general patterns of human behavior and culture. I think there is ample evidence making this an appropriate hypothesis. On the other hand, it does not follow, in any sense whatever, that Darwinism provides a basis for the construction of desirable political, economic, social, moral or ethical systems to be employed now or in the future. Darwinism's usefulness in these regards remains strictly in the realm of providing information that will assist humans in developing whatever system they may elect to strive for. It has no role in determining the nature of that system.

Conclusion

When one is a member of a frustrated minority, it is tempting to seek to force one's views on others. A society such as ours must constantly guard against such efforts if it is to move toward openness. Some creationists have implied repeatedly that society is already closed because editors will not publish their papers. It is easy to believe that critical referees are wrong and that one is being persecuted, and sometimes both complaints are well founded. But there are numerous scientific publications, and scientists do not usually seek to get laws passed to protect themselves from criticism.

No laws were ever passed saying that evolution had to be taught in biology courses. The prestige of evolutionary theory has been built by its impact on the thousands of biologists who have learned its power and usefulness in the study of living things. No laws need to be passed for creationists to do the same thing. Recently creationists have reiterated that all they want is to resolve these issues on purely scientific grounds, but their behavior with regard to the law suggests otherwise. Moore (1974) in asking whether there is need for legislative intervention, implies that such legislation may be the only way to "true academic freedom" unless high school biology teachers start teaching creation.

The greatest threat to society and to our children is not whether students are exposed to wrong ideas--after all, many high school biology students are legally adults with voting privileges and all high school biology students have already been exposed to many wrong ideas. What is important is whether each has been taught how and given the freedom to test new ideas, evaluate them, and respond appropriately. The question of whether evolution or creation or both are mentioned, supported or taught in any or all of the schools is trivial by comparison. As long as biology teachers conduct their courses in the spirit of free inquiry, open debate, and self-correcting searches for predictive theories and repeatable results, no parent need fear that his or her children are being subjected to anything but the best kind of preparation for life in the technologically complex and socially demanding society in which we live.

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